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Descriptions of Some Phytoseiide Mites (Acarina: Phytoseiidae). Part I. Nine New Species from British Columbia with Keys to the Species of British Columbia. Part II. Redescriptions of Eight Species Described by Berlese[1]

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PART I

In 1951 to 1955 Mr. N. H. Anderson of the Belleville laboratory, and Mr. C. V. G. Morgan, Entomology Laboratory, Summerland, B.C., collected plant material in southern British Columbia to investigate the distribution there of phytoseiid mites. Many phytoseiids in this material were apparently undescribed, and in 1956 the author collected further specimens. Nine undescribed forms were found; descriptions of these are given below, with a key for identifying the adult females of all phytoseiid species known to occur in British Columbia. The new species all are of the genus *Typhlodromus* Scheuten, 1957, as defined by Chant (in preparation). The mites were cleared in chloral hydrate or lactic acid and mounted in Berlese's fluid; but some were mounted directly in De Faure's fluid. The measurements given are of the greatest lengths and widths of the dorsal and ventri-anal shields, and whenever possible are the means for 10 specimens. The setal terminology of Garman (1948) and Nesbitt (1951) is followed. All specimens referred to were collected in British Columbia unless otherwise stated.

Subgenus TYPHLODROMUS Scheuten, 1857

T. (T.) singularis sp. n.

Figs. 1, 2

Female.—Length 329 μ; width 159μ. Dorsal shield moderately reticulated and having 18 pairs of setae, 10 in the lateral (L), two in the median (M), and six in the dorsal (D) rows (Fig. 1). All setae short and smooth. Three faint pores on shield mesad of setae L3, L6, and L9. Setae L1 to L5 equal to or only slightly longer than distances between their bases. Bases of setae L8, L9, and M2 forming a triangle with approximately equal sides.

Setae S1 and S2 on interscutal membrane. Peritreme with large, constricted, blunt, posterior projection. Sternal shield typical of the genus, with three pairs of setae. Oval metapodal plates with a fourth pair of setae. Genital shield typical of genus. Ventri-anal shield nearly oblong with slightly concave lateral margins (Fig. 2), 109μ long, 74μ wide, with three pairs of setae in addition to para-anals. Four pairs of setae surrounding ventri-anal shield.

Gnathosoma and maxillary palps typical of genus. Fixed digit of chelicera with pilus dentilis and usually with three teeth, though these are variable; movable digit with a single tooth. Legs normal and without specialized setae.

Male.—Ventri-anal shield with three pairs of setae in addition to para-anals. Chelicera with L-shaped spermatophoral process.

Diagnosis.—This species is apparently common on evergreens in western North America. Only one other species in the genus *Typhlodromus*, *T. transvaalensis* (Nesbitt), has 10 lateral setae on the dorsum and only three pairs of

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setae on the ventri-anal shield, and in this the lateral setae are very long and slightly serrated.

Locality and Type Material.—The holotype, a female collected from Douglas fir at McIntyre Creek on June 21, 1956, and the allotype male are in the Canadian National Collection (No. 6537). Additional specimens, collected from the following host plants, are in the collection of the Belleville laboratory: from ponderosa pine at Garnett Valley, lodgepole pine at Sunday Summitt and 28 miles north of Princeton, white pine at Mackinson's Flats, Fosthall, Silverton, and Caribou Creek, juniper at Seton Lake, *Thuya* sp. at Hedley, maple 20 miles east of Hope, sumac and mock orange (*Philadelphus lewisii* Pursh) at McIntyre Creek, black cottonwood (*Populus trichocarpa* T. & G.) at Keremeos, and willow at Fountain Valley and Meyer's Flats. Specimens in the U.S. National Museum have the following collection data: from ponderosa pine, Hood River, Oregon, May 23, 1951 (E. W. Baker), and from spruce, A. C. Campus, North Dakota, September 18, 1953 (V. Goodfellow).

T. (T.) validus sp. n.

Figs. 3-5

Female.—Length 363μ; width 189μ. Dorsal shield moderately reticulated and having 17 pairs of setae, nine in the lateral, two in the median, and six in the dorsal rows (Fig. 3). All anterior lateral setae shorter than distances between their bases, and all setae simple. Seta M2 arising approximately half way between bases of L7 and L8.

Seta S1 on interscutal membrane; S2 absent. Peritreme with large, scimitar-shaped, posterior projection. Sternal shield with three pairs of setae and occasionally with a posterior projection partially covering vulva (Fig. 5). Oval metapodal plates each with a single seta. Genital shield normal. Ventri-anal shield much longer (103μ) than broad (58μ), with markedly concave lateral margins causing it to appear sole-shaped (Fig. 4), and with three pairs of setae in addition to para-anals. Only two pairs of setae surrounding ventri-anal shield. In addition to long, slender parapodal plates, a number of small, imperfect plates present on posterior ventral surface of body.

Gnathosoma and maxillary palps normal. Fixed digit of chelicera with one small projection from which arises pilus dentilis; movable digit with one minute tooth. Legs normal, with one small macroseta on basitarsus IV.

Male.—Unknown.

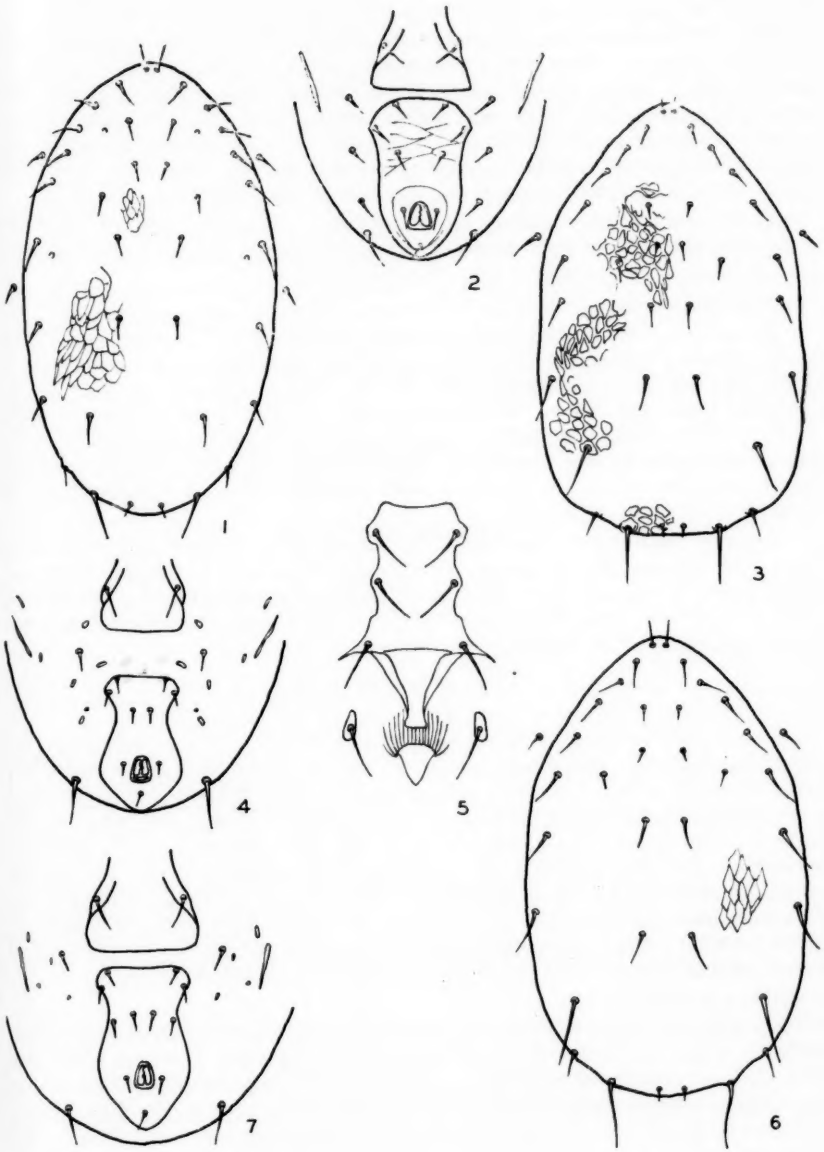
Diagnosis.—Dorsally, this species resembles both *T.* (*T.*) *pomi* (Parrott) and *T.* (*T.*) "new species" figured by Cunliffe and Baker (1953). However, the shape and chaetotaxy of the ventri-anal shield are distinctive.

Locality and Type Material.—The holotype, a female, was collected from ponderosa pine at McIntyre Creek, June 21, 1956. Thirteen paratypes were collected from the type locality on the same date. The holotype and these additional specimens are in the Canadian National Collection (No. 6538). Other specimens, collected from the following host plants, are in the collection of the Belleville laboratory: from black cottonwood at McIntyre Creek, wild cherry five miles west of Keremeos, and ponderosa pine at Garnett Valley. All were collected from the Okanagan region of British Columbia.

T. (T.) flumenis sp. n.

Figs. 6, 7

Female.—Length 320μ; width 185μ. Dorsal shield slightly reticulated and having 17 pairs of setae, nine in the lateral, two in the median, and six in the dorsal rows (Fig. 6). Setae L1 to L5 slightly shorter than distances between



Figs. 1-7. 1, *T.* (*T.*) *singularis*, dorsal shield; 2, *T.* (*T.*) *singularis*, posterior ventral surface; 3, *T.* (*T.*) *validus*, dorsal shield; 4, *T.* (*T.*) *validus*, posterior ventral surface; 5, *T.* (*T.*) *validus*, sternal shield. 6, *T.* (*T.*) *flumenis*, dorsal shield; 7, *T.* (*T.*) *flumenis*, posterior ventral surface.

their bases. Seta M2 closer to L8 than to L7. Setae D2, D3, and D4 less than half as long as distances between their bases. All setae smooth.

Seta S1 on interscutal membrane; S2 absent. Sternal shield bearing only two pairs of setae. Two pairs of metapodal plates present, each with a pair of setae. Genital shield normal. Ventri-anal shield much longer (104μ) than broad (68μ), oblong, with lateral margins concave, and with four pairs of setae in addition to para-anals (Fig. 7). Two pairs of setae surounding ventri-anal shield. One pair of parapodal plates long and narrow, the other small and ovoid; three other pairs of small and variable plates present.

Gnathosoma and maxillary palps normal. Movable digit of chelicera with one tooth; fixed digit probably with one tooth and with pilus dentilis. Legs normal, with macroseta on basitarsus IV.

Male.—Unknown.

Diagnosis.—This species resembles most closely *T.* (*T.*) *pomi* but differs from it in the shape of the ventri-anal shield and by having only two instead of three pairs of setae surrounding the shield. The shape and number of the parapodal plates also differ in these two species. *T.* (*T.*) *flumenis* also resembles *T.* (*T.*) "new species" figured but not described by Cunliffe and Baker (1953), but differs in that setae L1 to L5 are slightly longer, D2, D3, and D4 are much longer, and the ventri-anal shield is more strongly rounded anteriorly in the latter than in *T.* (*T.*) *flumenis*.

Locality and Type Material.—The holotype, a female collected from soopolallie (*Shepherdia canadensis* Nutt). eight miles west of Hedley along the Similkameen River on July 12, 1956, is in the Canadian National Collection (No. 6539). Two specimens collected from white pine at Caribou Creek are in the collection of the Belleville laboratory.

T. (T.) arboreus sp. n.

Figs. 8, 9

Female.—Dorsal surface as in *T.* (*T.*) *pini* Chant (1955) except setae M2 and D5 much longer, the former being as long as the distance between its base and that of L7 (Fig. 8). Ventrally, only minor differences occur. A very small parapodal plate is present in *T.* (*T.*) *arboreus* beside the long slender plate, but not in *T.* (*T.*) *pini*. Also, in the new species a small, elongate, sclerotized plate lies between the ventri-anal and genital shields, and on the ventri-anal shield the anus is farther posterad than in *T.* (*T.*) *pini* (Fig. 9). The new species differs from all others in the genus with only eight pairs of lateral setae on the dorsum in the shape of the ventri-anal shield, the presence of a macroseta on leg IV, and the length of the setae on the dorsal shield.

Male.—Unknown.

Locality and Type Material.—The holotype, a female collected from apple leaves in Vancouver on May 27, 1956, is in the Canadian National Collection (No. 6540). Additional specimens, with the following collection data, are in the collection of the Belleville laboratory: from white pine at Fosthall, arbutus at Victoria, apricot at Wilson's Landing, and greengage plum at Lillooet. All specimens except the holotype were collected by N. H. Anderson and C. V. G. Morgan.

Subgenus AMBLYSEIUS Berlese, 1914

T. (A.) berlesei sp. n.

Fig. 10

Female.—Length 445μ; width 230μ. Dorsal shield smooth and as in *T.* (*A.*) *perlongisetus* Berlese (see below). Ventri-anal shield 122μ long, 113μ

wide, and as in Berlese's species except with a pair of pores (Fig. 10). Only three pairs of setae surrounding ventri-anal shield, and two pairs of parapodal plates present, one minute. A transverse fold present between the genital and ventri-anal shields. Peritreme uniformly broad with a tapering, truncate, posterior projection curving sharply around the base of coxa IV. In Berlese's specimens this projection may not be so extremely curved, but insufficient specimens of both forms were examined to make this observation conclusive. Chelicera with five denticules on fixed digit and pilus dentilis; movable digit with three teeth. Legs normal, with three macrosetae on leg IV.

Male.—Ventri-anal shield with three pairs of setae in addition to para-anals. Hammer-shaped spermatophoral process present on movable digit of chelicera.

Diagnosis.—Because morphological differences between this form and *T. (A.) perlongisetus*, though slight, are consistent and the forms are not allopatric in distribution, they are considered distinct species.

Locality and Type Material.—The holotype, a female collected from *Ranunculus* sp. at Nakusp on July 31, 1954, by N. H. Anderson, C. V. G. Morgan, and M. D. Proverbs, is in the Canadian National Collection (No. 6541). Four paratypes collected at the type locality are in the collection of the Belleville laboratory, together with additional specimens from *Ranunculus* sp. and from birch (*Betula* sp.) at the type locality.

T. (A.) okanagensis sp. n.

Figs. 11, 12

Female.—Length 381μ; width 234μ. Dorsal shield slightly reticulated and having 16 pairs of setae, nine in the lateral, two in the median, and five in the dorsal rows (Fig. 11). All setae smooth. Setal measurements (μ) as follows: L1,47; L2,33; L3,63; L4,74; L5,21; L6,40; L9,90; M2,70. Remaining setae minute except D1. Seta L2 shorter than L1 or L3, seta L5 approximately half as long as L6. Seta D5 absent. A number of minute pores or punctures present on dorsum (eight pairs in holotype).

Setae S1 and S2 on interscutal membrane. Peritreme narrow, with a posterior portion bulbous at first, tapering to a slender projection that curves around base of coxa IV. Sternal shield normal, with three pairs of setae. One pair of metapodal plates present, each with a seta. Genital shield normal. Ventri-anal shield nearly as broad (115μ) as long (121μ) with posterior margin rounded and lateral margins convex, reticulated, and with three pairs of setae in addition to para-anals (Fig. 2). Shield surrounded by four pairs of setae, one (VL1) being moderately long (50μ), the remainder short. Two pairs of parapodal plates present, and as many as five minute sclerotized plates between these and ventri-anal shield. A lateral fold present between genital and ventri-anal shields, along this being four slender, elongate, sclerotized plates. Therefore, in addition to the parapodal plates as many as seven pairs of small plates are found on the posterior ventral surface of the body.

Gnathosoma and maxillary palps normal. Fixed digit of chelicera with eight or more minute denticules and pilus dentilis; movable digit with one tooth. Legs normal, with three macrosetae on leg IV.

Male.—Ventri-anal shield with three pairs of setae in addition to para-anals. Movable digit of chelicera with spur-shaped spermatophoral process.

Diagnosis.—This species is distinguished by the relative lengths of setae L2 and L5, by the absence of seta D5, by the shape and texture of the ventri-anal shield, and by the large number of minute sclerotized plates on the posterior ventral surface of the female.

Locality and Type Material.—The holotype, a female collected from peach foliage at Oliver, on August 16, 1955, by N. H. Anderson and C. V. G. Morgan, is in the Canadian National Collection (No. 6542). Other specimens, collected by N. H. Anderson and C. V. G. Morgan, with collection data as follows, are in the collection of the Belleville laboratory: from "cover crop", apple leaves, and burdock at Summerland.

T. (A.) morgani sp. n.

Figs. 13, 14

Female.—Length 398μ; width 365μ. Dorsal shield smooth and having 17 pairs of setae, nine in the lateral, two in the median, and six in the dorsal rows (Fig. 13). Setae D1, L1, L4, L9, and M2 the only long setae present (25, 51, 86, 106, and 99μ respectively); remaining setae minute. Setae M2 and L7 closer to each other than to L8.

Setae S1 and S2 minute, and on interscutal membrane. Peritreme very broad throughout, with long posterior projection curving sharply around coxa IV and ending in rounded lobe. Sternal shield strongly reticulated, with three pairs of setae. A pair of large metapodal plates present, each with a seta. Genital shield reticulated, more strongly truncate posteriorly than normally. Ventri-anal shield large, wider (176μ) than long (144μ) and wider than genital shield, with three pairs of setae in addition to para-anals, and a pair of pores (Fig. 14). Four pairs of setae surrounding ventri-anal shield, one (VL1) of moderate length (36μ), the remainder short. Two pairs of parapodal plates present. In addition, a small, circular plate laterad of anterior edge of ventri-anal shield, and two pairs of elongate, slender plates between the ventri-anal and genital shields.

Gnathosoma and maxillary palps normal. Movable digit of chelicera with one small tooth; fixed digit with a variable number (usually six) of minute denticules and pilus dentilis. Legs normal, with three macrosetae on leg IV.

Male.—Unknown.

Diagnosis.—The arrangement and lengths of the dorsal setae and the shape and texture of the ventri-anal shield make this species distinct from other members of the subgenus.

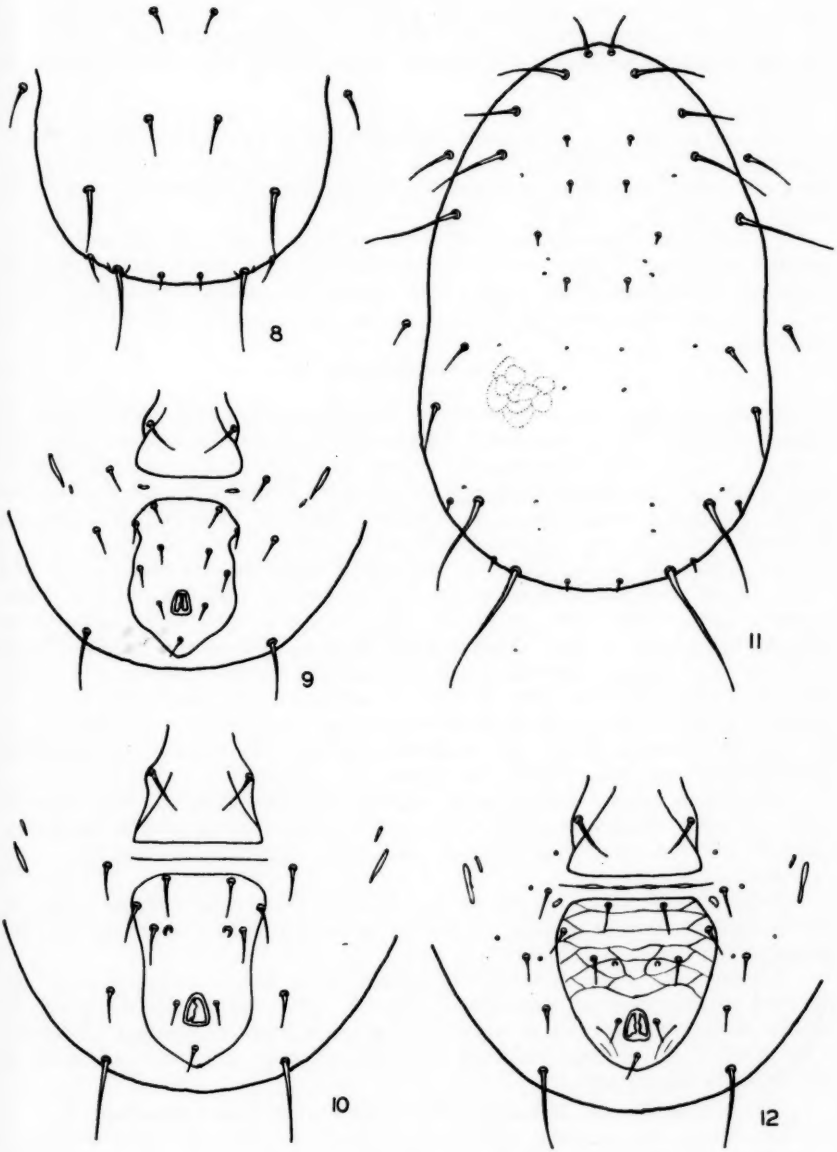
Locality and Type Material.—The holotype, a female, was collected from dandelion at Trout Creek Point, Summerland, on June 27, 1955, by C. V. G. Morgan, in whose honour the species is named, and is in the Canadian National Collection (No. 6543). Three paratypes, collected from the type locality on the same date as above, are in the collection of the Belleville laboratory.

T. (A.) desertus sp. n.

Figs. 15, 16

Female.—Length 365μ; width 199μ. Dorsal shield reticulated and having 17 pairs of setae, nine in the lateral, two in the median, and six in the dorsal rows (Fig. 15). Setae L9 and M2 slightly serrated and longer than all other setae, which are short and smooth. Setae L1 to L4 shorter than distances between their bases. Bases of setae M2, L7, and L8 forming a triangle with approximately equal sides.

Setae S1 and S2 on interscutal membrane. Peritreme slender, with large, truncate, posterior extension curving around base of coxa IV. Sternal shield normal, with three pairs of setae. One pair of metapodal plates present, each with a seta. Genital shield normal, equal in width to ventri-anal shield. Ventri-anal shield slightly reticulated, oblong with posterior margin rounded and lateral margins slightly concave, 117μ long, 77μ wide, and with three pairs of



Figs. 8-12. 8, *T.* (*T.*) *arboreus*, dorsal shield; 9, *T.* (*T.*) *arboreus*, posterior ventral surface; 10, *T.* (*A.*) *berlesei*, posterior ventral surface; 11, *T.* (*A.*) *okanagensis*, dorsal shield; 12, *T.* (*A.*) *okanagensis*, posterior ventral surface.

setae in addition to para-anals (Fig. 16). Four pairs of setae surrounding ventri-anal shield. Two pairs of parapodal plates present, and four additional pairs of small, oval plates lying between the parapodals and the ventri-anal shield.

Gnathosoma and maxillary palps normal. Chelicera impossible to examine because of the positions of the specimens. Legs normal and without specialized setae.

Male.—Unknown.

Diagnosis.—Dorsally, this species resembles both *T.* (*A.*) *reticulatus* Oudemans and *T.* (*A.*) *cucumeris* Oudemans, though it is more markedly reticulated than the latter. It differs from both by having a long and narrow ventri-anal shield.

Locality and Type Material.—The holotype, a female, was collected from black cottonwood at McIntyre Creek on June 21, 1956, and is in the Canadian National Collection (No. 6544). An additional specimen, collected from willow eight miles west of Hedley, is in the collection of the Belleville laboratory.

***T. (A.) andersoni* sp. n.**

Figs. 17, 18

Female.—Length 349μ; width 192μ. Dorsal shield smooth, with 17 pairs of setae, nine in the lateral, two in the median, and six in the dorsal rows (Fig. 17). Setae L1, L4, L9, and M2 moderately or very long (59, 77, 163, and 68μ respectfully). Setae L3 and L6 approximately twice as long as setae L2 and L5, which are short. Remaining setae minute except D1. Bases of setae M2, L7, and L8 forming a triangle with approximately equal sides.

Setae S1 and S2 short and on interscutal membrane. Peritreme narrow, with slender posterior portion curving around base of coxa IV. Sternal shield normal, with three pairs of setae. One pair of oval metapodal plates present, each with a seta. Genital shield normal. Ventri-anal shield oblong with posterior margin rounded and lateral margins slightly concave, 122μ long, 94μ wide, and with three pairs of setae in addition to para-anals, and a pair of pores (Fig. 18). Four pairs of setae surrounding ventri-anal shield, one (VL1) of moderate length (72μ), the remainder minute. Two pairs of parapodal plates present, one very slender and short.

Gnathosoma and maxillary palps normal. Movable digit of chelicera with only one weak tooth; fixed digit with many (at least seven) minute denticules, pilus dentilis not seen. Legs normal, with three macrosetae on leg IV.

Male.—Unknown.

Diagnosis.—This species can be distinguished from others of the subgenus by the relatives lengths of setae L2 and L3 and of L5 and L6, together with the shape of the ventri-anal shield.

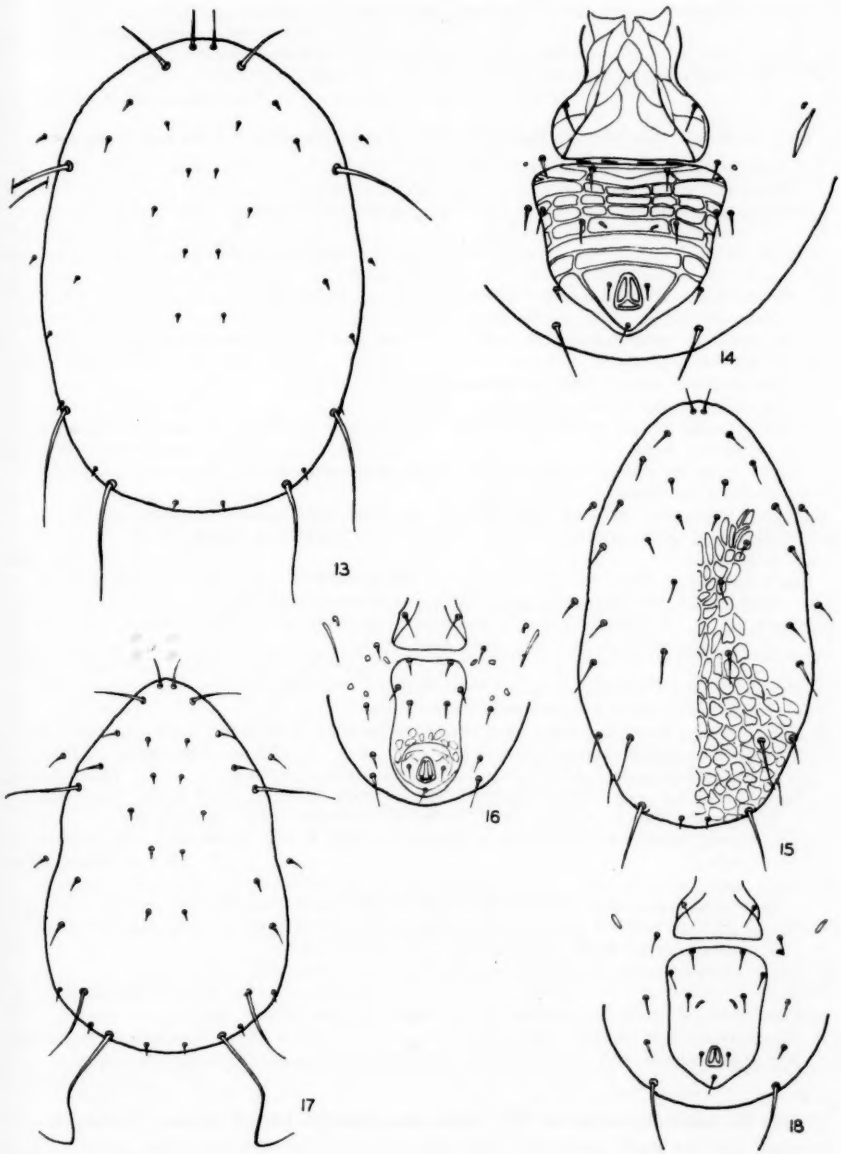
Locality and Type Material.—The holotype, a female collected from unsprayed prune foliage at Rosedale on July 21, 1955, by N. H. Anderson, in whose honour the species is named, is in the Canadian National Collection (No. 6545). A paratype collected with the holotype is in the collection of the Belleville laboratory.

Key to Genera of Known Phytoseiidae of British Columbia[3]

1. Some lateral setae on dorsal shield long, serrated, and greatly thickened; seta D5 absent; seta S1 on dorsal shield associated with seta L5 ..... Genus *Phytoseius* Ribaga
   Lateral setae on dorsal shield not greatly thickened or serrated and only occasionally long; seta D5 usually present; seta S1 on interscutal membrane ..... Genus *Typhlodromus* Scheuten

Only one species of *Phytoseius*, *P. macropilis* (Banks), has been found in British Columbia.

[3]Generic and specific separations are valid only for the species included in this paper.



Figs. 13-18. 13, *T.* (*A.*) *morgani*, dorsal shield; 14, *T.* (*A.*) *morgani*, posterior ventral surface; 15, *T.* (*A.*) *desertus*, dorsal shield; 16, *T.* (*A.*) *desertus*, posterior ventral surface; 17, *T.* (*A.*) *andersoni*, dorsal shield; 18, *T.* (*A.*) *andersoni*, posterior ventral surface.

Key to Subgenera of *Typhlodromus* of British Columbia

1. Five or more pairs of anterior lateral setae present on dorsal shield; if both S1 and and S2 present, then more than one lateral seta (L) between their bases ..... Subgenus *Typhlodromus* Scheuten
   Only four pairs of anterior lateral setae present on dorsal shield; if both S1 and S2 present, then only one lateral seta (L) between their bases ..... Subgenus *Amblyseius* Berlese

Key to Adult Females of the Subgenus *Typhlodromus* of British Columbia

1. Eight pairs of lateral setae on dorsal shield 2
   More than eight pairs of lateral setae on dorsal shield 4
2. Setae D2 to D4, M1, and L1 to L5 as long as distances between their bases; all setae on dorsal shield moderately long ..... *T.* (*T.*) *conspicuus* (Garman)
   Setae D2 to D4, M1, and L1 to L5 much shorter than distances between their bases; all setae on dorsal shield except M2 and L8 short 3
3. M2 much shorter than distance between its base and that of L7; one pair of parapodal plates present ..... *T.* (*T.*) *pini* Chant
   M2 equal to distance between its base and that of L7; two pairs of parapodal plates present ..... *T.* (*T.*) *arboreus* sp.n.
4. Nine pairs of lateral setae on dorsal shield 5
   Ten pairs of lateral setae on dorsal shield 9
5. All setae on dorsal shield very long; dorsal setae reaching at least to bases of succeeding setae ..... *T.* (*T.*) *occidentalis* Nesbitt
   Some setae on dorsal shield minute or of only moderate length; dorsal setae not reaching to bases of succeeding setae 6
6. Seta L8 midway between L9 and L7, on the same horizontal plane as M2; a prominent pore present between L8 and L9; ventri-anal shield almost as broad as long ..... *T.* (*T.*) *tiliae* Oudemans
   Seta L8 much closer to L9 than to L7, not associated with M2; no pore present between L8 and L9; ventri-anal shield much longer than broad 7
7. Setae L1 to L4 slightly longer than distances between their bases; seta M2 as long as distance between its base and that of L9 ..... *T.* (*T.*) 'new species' (See Cunliffe and Baker, 1953)
   Setae L1 to L4 shorter than distances between their bases; seta M2 shorter than distance between its base and that of L9 8
8. Setae L1 to L4 much shorter than distances between their bases; lateral margins of ventri-anal shield deeply concave; five pairs of small sclerotized plates, in addition to parapodals, scattered over posterior ventral surface of body ..... *T.* (*T.*) *validus* sp. n.
   Setae L1 to L4 only slightly shorter than distances between their bases; ventri-anal shield with lateral margins only shallowly concave; only three pairs of small sclerotized plates, in addition to parapodals, scattered over posterior ventral surface of body ..... *T.* (*T.*) *flumenis* sp. n.
9. Only two pairs of setae on ventri-anal shield in addition to para-anals; 19 pairs setae on dorsal shield (three setae in each median row) ..... *T.* (*T.*) *soleiger* (Ribaga)
   Three or four pairs of setae on ventri-anal shield in addition to para-anals; 18 pairs of setae on dorsal shield (two setae in each median row) 10
10. Three pairs of setae, in addition to para-anals, on ventri-anal shield ..... *T.* (*T.*) *singularis* sp. n.
    Four pairs of setae, in addition to para-anals, on ventri-anal shield 11
11. Ventri-anal shield simple, uncreased ..... *T.* (*T.*) *rhenanus* (Oudemans)
    Ventri-anal shield with a number of deep folds or creases encircling the anus ..... *T.* (*T.*) *bakeri* (Garman)

Key to Adult Females of the Subgenus *Amblyseius* of British Columbia

1. Eight pairs of lateral setae on dorsal shield ..... *T.* (*A.*) *aberrans* Oudemans
   Nine pairs of lateral setae on dorsal shield 2
2. Lateral setae L1, L4, L9, and M2 on dorsal shield much longer than others 3
   No lateral setae on dorsal shield of extreme length 9
3. Seta L2 approximately as long as L3 4
   Seta L2 shorter or longer than L3 7
4. Seta L2 and L3 minute 5
   Setae L2 and L3 longer ..... *T.* (*A.*) *fraterculus* (Berlese)

5. Ventri-anal shield broader than long, reticulated ..... *T. (A.) morgani* sp. n.
Ventri-anal shield longer than broad, not reticulated 6
6. Ventri-anal shield surrounded by four pairs of setae ..... *T. (A.) perlongisetus* (Berlese)
Ventri-anal shield surrounded by three pairs of setae ..... *T. (A.) berlesei* sp. n.
7. Seta L2 longer than L3; seta L6 equal in length to L5, both minute ..... *T. (A.) obtusus* (Berlese)
Seta L3 longer than L2; seta L6 longer than L5 and not minute 8
8. Seta D5 absent ..... *T. (A.) okanagensis* sp. n.
Seta D5 present ..... *T. (A.) andersoni* sp. n.
9. Ventri-anal shield almost oval; preanal setae on anterior third of shield, almost in transverse row ..... *T. (A.) finlandicus* (Oud.)
Ventri-anal shield approximately rectangular or triangular; preanal setae arranged as a triangle 10
10. Ventri-anal shield oblong, much longer than broad ..... *T. (A.) desertus* sp. n.
Ventri-anal shield somewhat triangular, not or only slightly longer than broad 11
11. Setae L1 to L4 longer than distances between their bases 12
Setae L1 to L4 shorter than distances between their bases 13
12. Setae D2, D3, M1, and D4 shorter than distances between their bases; dorsal shield longer than 400 μ ..... *T. (A.) masseei* Nesbitt
Setae D2, D3, M1, and D4 longer than distances between their bases; dorsal shield not longer than 400 μ ..... *T. (A.) fallacis* (Garman)
13. Ventri-anal shield as broad as long ..... *T. (A.) reticulatus* Oudemans
Ventri-anal shield longer than broad 14
14. Setae L1, L2, and L3 less than half as long as distances between their bases ..... *T. (A.) marinus* (Willmann)
Setae L1, L2, and L3 more than half as long as distances between their bases ..... *T. (A.) cucumeris* Oudemans

PART II

Berlese (1914) described eight species of phytoseiid mites and placed them in the genus *Amblyseius*. Two of these were found in British Columbia during the present study and are included in the keys. However, Berlese figured only one surface of some of these species, and his descriptions of all were inadequate and less detailed than is necessary for identification. In this regard, therefore, his work is of little use to acarologists who are unable to study his collections. In 1955 the author studied Berlese's type specimens, from which the redescriptions given herein were prepared. All the species are now considered to be of the subgenus *Amblyseius* of the genus *Typhlodromus*. The specimens and slides in the Berlese Collection are labelled with the numbers referred to herein.

Subgenus *AMBLYSEIUS* Berlese, 1914

T. (A.) perlongisetus (Berlese)

Figs. 19, 20

Three specimens of this species are in the Berlese Collection. Specimen 168/26, the holotype, and Specimen 168/24 are too damaged for critical examination but Specimen 170/46 is in good condition and the redescription was prepared from this. All three specimens were collected in La Plata, Argentina.

Female.—Dorsal shield smooth, with 17 pairs of setae: nine in the lateral, two in the median, and six in the dorsal rows (Fig. 19). Setae L4, L9, and M2 long (greater than 100μ) and whiplike, setae D1 and L1 longer than remaining setae on dorsum, which are minute. Bases of setae L7, L8, and M2 forming a triangle with approximately equal sides.

Setae S1 and S2 minute and on interscutal membrane. Sternal shield normal, with three pairs of setae. One pair of metapodal plates present, each with a seta. Genital shield normal. Ventri-anal shield oblong with posterior margin rounded, lateral margins parallel, and slightly convex anterior margin,

and with three pairs of setae in addition to para-anals (Fig. 20). Four pairs of setae surrounding the ventri-anal shield, one (VL1) long and whiplike, the remainder minute. One or two pairs of parapodal plates present.

Gnathosoma and maxillary palps normal. Chelicera impossible to examine because of condition of specimen. Legs normal, with three macrosetae on leg IV.

Male.—Unknown.

Diagnosis.—The minute size of setae L2, L3, and L5 to L8 on the dorsum and the shape of the ventri-anal shield are distinctive. Two specimens of this species, now in the collection of the Belleville laboratory, were collected in British Columbia in 1956, one from birch at Nakusp, and one from wild gooseberry at Garnett Valley Dam, Summerland.

T. (A.) fraterculus (Berlese)

Figs. 21, 22

Two specimens of this species are in the Berlese Collection. The type, Specimen 8/36, from La Plata, Argentina, is too damaged for description. The other specimen, number 115/19, from Montevideo, is in good condition and the redescription was prepared from it.

Female.—Dorsal shield smooth, with 17 pairs of setae: nine in the lateral, two in the median, and six in the dorsal rows (Fig. 21). Setae of dorsal rows minute except D1. Setae L4, L9, and M2 long or very long, but not whiplike as in many other members of the subgenus. Setae L2 and L3 slightly shorter than L1 and much shorter than L4. Setae L2, L3, L5, and L6 approximately equal in length. Base of seta M2 closer to that of L7 than to that of L8.

Interscutal membrane impossible to examine. Sternal shield with long lateral extension between coxae II and III, with posterior margin excavated, and with three pairs of setae. Metapodal plates large, each with a seta. Genital shield normal. Ventri-anal shield almost square with posterior margin rounded and lateral margins slightly convex, with three pairs of setae in addition to para-anals, and with a pair of pores (Fig 22). Four pairs of setae surrounding ventri-anal shield. One pair of long, slender parapodal plates present.

Gnathosoma and maxillary palps normal. Chelicera impossible to examine because of condition of specimen. Legs normal, with three macrosetae on leg IV.

Male.—Unknown.

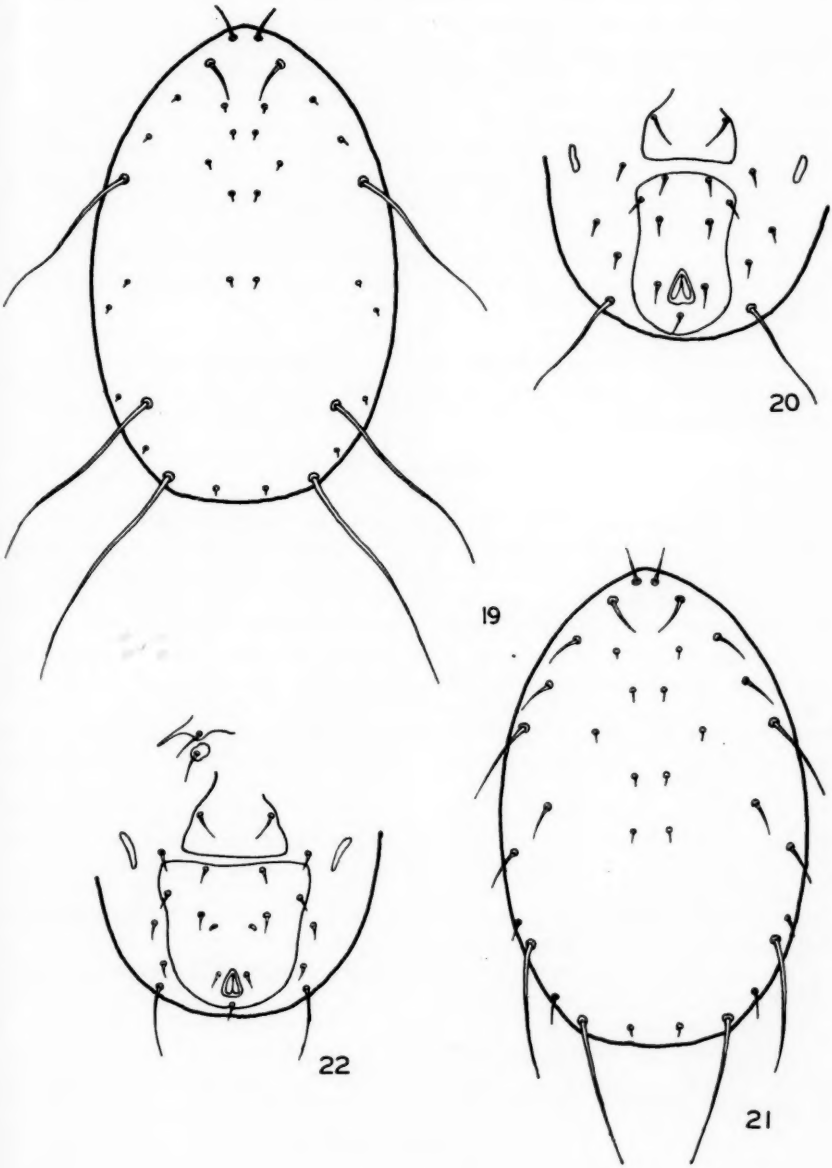
Diagnosis.—The relative lengths of the lateral setae on the dorsal shield are distinctive. A male specimen with dorsal chaetotaxy similar to that of the female described above was collected in British Columbia from a decayed stump at McIntyre Creek and is tentatively considered to be of this species.

T. (A.) foenalis (Berlese)

Figs. 23, 24

Only one specimen of this species, number 150/7, is present in the Berlese Collection. It was collected from leaf detritus in Boboli Park, Florence. Berlese collected extensively in this park but his captures do not necessarily indicate that a species is native to Italy; the park contains an arboretum and many of the mites there may have been introduced with the host plants.

Female.—Dorsal shield smooth, with 17 pairs of setae: nine in the lateral, two in the median, and six in the dorsal rows (Fig. 23). Setae of dorsal rows minute except D1. Seta L4 long (120 μ), setae L9 and M2 long, whiplike (250 μ and 170 μ respectively). Seta L2 and L1 equal in length. Setae L5



Figs. 19-22. 19, *T.* (*A.*) *perlongisetus* (Berlese), dorsal shield; 20, *T.* (*A.*) *perlongisetus* (Berlese), posterior ventral surface; 21, *T.* (*A.*) *fraterculus* (Berlese), dorsal shield; 22, *T.* (*A.*) *fraterculus* (Berlese), posterior ventral surface.

and L6 short and equal in length. Seta L3 approximately one third length of L2. Base of seta M2 approximately halfway from bases of setae L7 and L8.

Interscutal membrane impossible to examine. Sternal shield with long lateral projection between coxae II and III, and with three pairs of setae. A pair of small metapodal plates lying very close to sternal shield, each with a seta. Genital shield normal. Ventri-anal shield triangular with three pairs of setae in addition to para-anals (Berlese, 1914, observed only two preanal setae in some specimens but this condition has not been seen by the present author), and with a pair of conspicuous pores (Fig. 24). Four pairs of setae surrounding ventri-anal shield, one (VL1) very long, the remainder minute. A single long, slender parapodal plate present.

Gnathosoma and maxillary palps apparently normal. Chelicera impossible to examine because of condition of specimen. Legs normal, with three macrosetae on leg IV.

Male.—Unknown.

Diagnosis.—The relative lengths of setae L2 and L3, and of L5 and L6 on the dorsal shield, together with the triangular shape of the ventri-anal shield are distinctive. This species has not been recorded since Berlese described it in 1914.

T. (A.) aequipilus (Berlese)

Figs. 25, 26

Only one specimen of this species is in the Berlese Collection. This holotype, number 113/39, from Java, is badly damaged and the long setae of the dorsal shield are missing. However, Berlese gave the measurements of these in his original description and this information together with the details which are still visible on the specimen enabled the redescription to be prepared.

Female.—Dorsal shield smooth, with 17 pairs of setae: nine in the lateral, two in the median, and six in the dorsal rows (Fig. 25). Setae of dorsal rows minute except D1. Setae L4, L9, and M2 moderately long (70, 80, and 80 μ long respectively). Setae L5 and L6 minute. Setae L1 and L2 of equal length, approximately half as long as L4, and slightly longer than L3. Base of seta M2 halfway between bases of setae L7 and L8.

Interscutal membrane impossible to examine because of condition of specimen. No details of the ventral surface anterior to genital shield could be discerned. Genital shield normal. Ventri-anal shield oblong with posterior margin rounded and lateral margins converging slightly, and with three pairs of setae in addition to para-anals (Fig. 26). Four pairs of setae surrounding ventri-anal shield. Parapodal plates not evident.

Gnathosoma, maxillary palps and chelicera impossible to examine. Legs normal, with three macrosetae on leg IV.

Male.—Unknown.

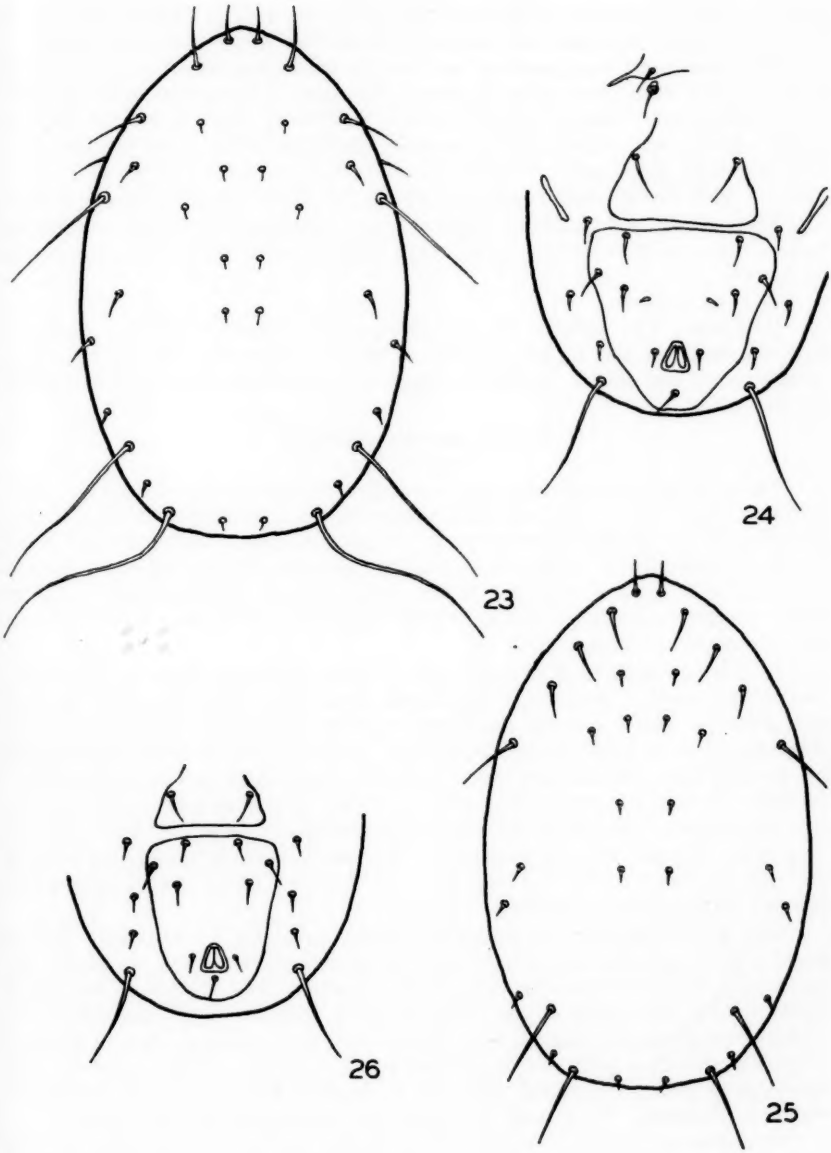
Diagnosis.—The relative lengths of setae L5 and L6, and L2, L3, and L4, together with the shape of the ventri-anal shield are distinctive. This species has not been recorded since Berlese described it in 1914.

T. (A.) longulus (Berlese)

Figs. 27, 28

Three specimens of this species are present in the Berlese Collection: 150/8, from moss at Toviano, Italy, and 155/20 and 115/18, both from Pisa, Italy. The last was designated by Berlese as the holotype. All are in poor condition but sufficient detail could be seen for the species to be characterized.

Female.—Dorsal shield with 17 pairs of setae: nine in the lateral, two in



Figs. 23-26. 23, *T.* (*A.*) *foenalis* (Berlese), dorsal shield; 24, *T.* (*A.*) *foenalis* (Berlese), posterior ventral surface; 25, *T.* (*A.*) *aequipilus* (Berlese), dorsal shield; 26, *T.* (*A.*) *aequipilus* (Berlese), posterior ventral surface.

the median, and six in the dorsal rows (Fig. 27). Setae L4, L9 and M2 long (55, 120 and 119 μ respectively). Seta L1 approximately half as long as L4, and setae L2 and L3 equal in length and approximately half as long as L1. Setae L5 and L6 equal in length and minute. Remaining setae on dorsum minute.

The interscutal membrane of this species could not be examined. Sternal shield normal, with three pairs of setae. One pair of metapodal plates present, each with a seta. Genital shield broader posteriorly than is normal for the genus. Ventri-anal shield broad, triangular in shape with lateral margins convex, and with three pairs of setae in addition to para-anals (Fig. 28). Four pairs of setae surrounding ventri-anal shield. A single parapodal plate present.

Gnathosoma and maxillary palps normal. Chelicera impossible to examine because of condition of specimen. Legs normal, with three long macrosetae on leg IV.

Male.—Unknown.

Diagnosis.—This species can be distinguished by the relative lengths of setae L2 and L3, and of L5 and L6 on the dorsal shield, and by the shape of the ventri-anal shield. It has not been recorded since it was described by Berlese in 1914.

T. (A.) grandis (Berlese)

Figs. 29, 30

Three slides labelled with this name are in the Berlese Collection. Slide 170/42, labelled as a type, contains specimens of *Lasioseius fissuratus* Berlese but none of the genus *Typhlodromus*. A second slide, number 170/43, from La Plata, Argentina, is obscured by ringing material. The third slide, number 168/22, also labelled a type and herein proposed as a lectotype, from Buenos Aires, contains a specimen in fairly good condition and it was from this that the redescription was made.

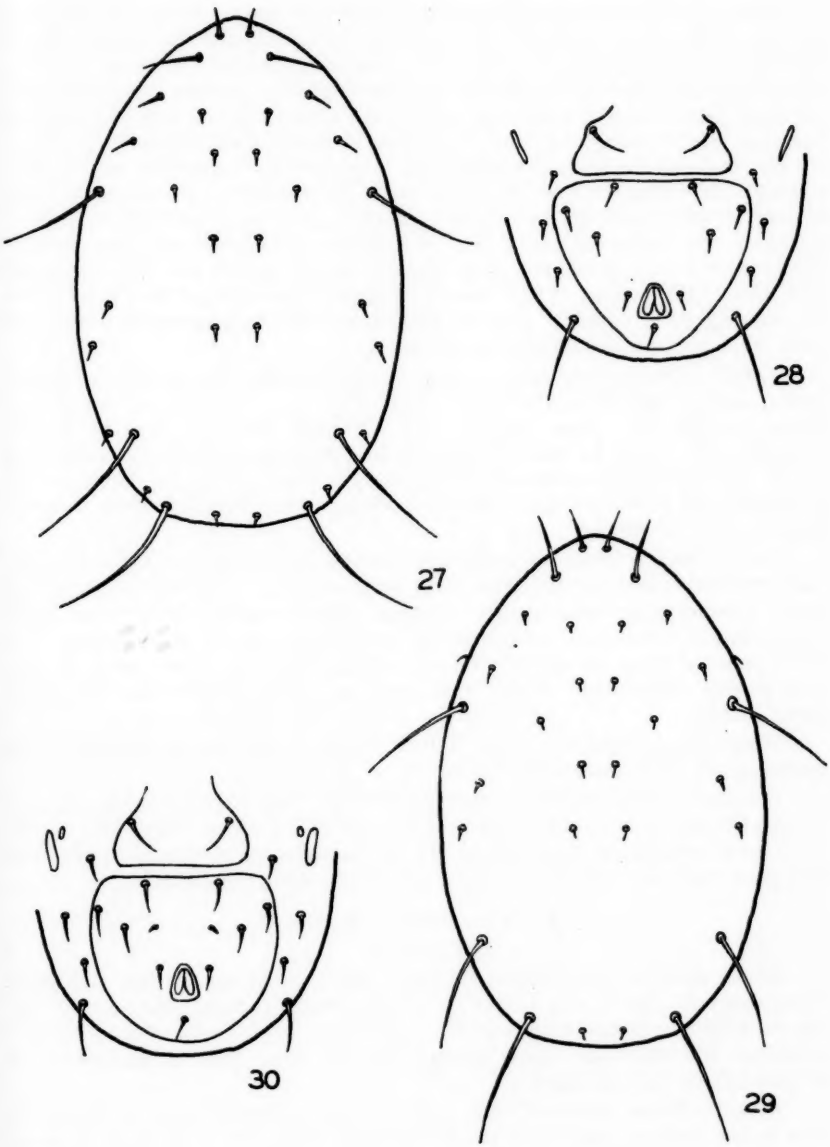
Female.—Dorsal shield smooth, with 15 pairs of setae: seven in the lateral, two in the median, and six in the dorsal rows (Fig. 29). Setae L7 and L8 appear to be absent but the specimen was not sufficiently well-preserved to determine if their positions are marked by pores, or even if very minute setae are present here. Subsequent authors showed these setae absent in their illustrations, but because Berlese illustrated only the ventral surface of this species, it is not known where this information was obtained. Setae L4, L"7" and M2 long (135, 260, and 300 μ respectively – the mite itself is very large: 540 μ long and 400 μ wide). Setae L2 and L3, and L5 and L6 of equal length and minute. Seta LI approximately 70 μ long.

Seta S1 minute and on interscutal membrane; seta S2 not seen. Sternal shield with long lateral projections curving around coxa II both anteriorly and posteriorly, and with three pairs of setae. One pair of conspicuous metapodal plates present, each with a seta. Genital shield normal. Ventri-anal shield oval with flattened anterior margin, very broad, with three pairs of setae in addition to para-anals and a pair of conspicuous pores (Fig. 30). Four pairs of setae surrounding ventri-anal shield, one (VL1) slightly longer than the remainder, which are minute. Two pairs of parapodal plates present, one minute.

Gnathosoma, maxillary palps, and chelicera impossible to examine because of condition of specimen. Legs normal, with three macrosetae on leg IV.

Male.—Unknown.

Diagnosis.—Because of the difficulty in determining if setae L7 and L8 are absent, the identity of this species must remain in doubt. If absent, this feature distinguishes the species. If present, the relative lengths of setae L2 and L3 and of L5 and L6, with the oval, very broad, ventri-anal shield are distinctive.



Figs. 27-30. 27, *T.* (*A.*) *longulus* (Berlese), dorsal shield; 28, *T.* (*A.*) *longulus* (Berlese), posterior ventral surface; 29, *T.* (*A.*) *grandis* (Berlese), dorsal shield; 30, *T.* (*A.*) *grandis* (Berlese), posterior ventral surface.

T. (A.) obtusus (Berlese) (Ex. Koch)

Figs. 31, 32

Berlese obviously believed his specimens of this species to be identical with the species described by C. L. Koch (1839) as *Zercon obtusus*, though Koch's description and drawings are inadequate for identification. In addition to redescribing Koch's specimens, Berlese also described two varieties, *tuscus* and *meridionalis*. There are two specimens of *T. (A.) obtusus* in the Berlese Collection (numbers 19/10 and 22/14, both from moss in Boboli Park, Florence) but they are too damaged for critical examination. There is also a specimen of var. *meridionalis*, also damaged, from Treviglio, Italy. No specimens of var. *tuscus* could be located, and therefore the identity of these varieties cannot be established. However, the redescription of *T. (A.) obtusus* was prepared from Berlese's drawings and description and from the few details which can be seen on the type slide. Womersley (1954) described this species from Australia but from his drawings it is apparent that his specimens were incorrectly identified and were of a previously undescribed species.

Female.—Dorsal shield smooth, with 17 pairs of setae: nine in the lateral, two in the median, and six in the dorsal rows (Fig. 31). All setae in dorsal rows minute, except D1. Setae L4, L9, and M2 long (80, 140, and 200 μ long respectively). Setae L1 and L2 equal in length, approximately a third as long as L4. Setae L3 short, approximately half as long as L1 or L2. Setae L5 and L6 minute and of equal length. Seta M2 arising approximately halfway between bases of setae L7 and L8.

Interscutal membrane impossible to examine because of condition of specimen. Sternal shield normal, with three pairs of setae. One pair of metapodal plates present, each with a seta. Genital shield normal. Ventri-anal shield approximately triangular, with rounded, converging, lateral margins, and with three pairs of setae in addition to para-anals (Fig. 32). Four pairs of setae surrounding ventri-anal shield. One pair of small, rectangular parapodal plates present.

Gnathosoma, maxillary palps, and chelicera impossible to examine. Legs normal, with three macrosetae on leg IV.

Diagnosis.—This species is distinguished by the relative lengths of setae L2 and L3, and of L5 and L6, and by the shape of the ventri-anal shield. Specimens were collected at Summerland, British Columbia in 1955 from apple leaves and grass and these are in the collection of the Belleville laboratory.

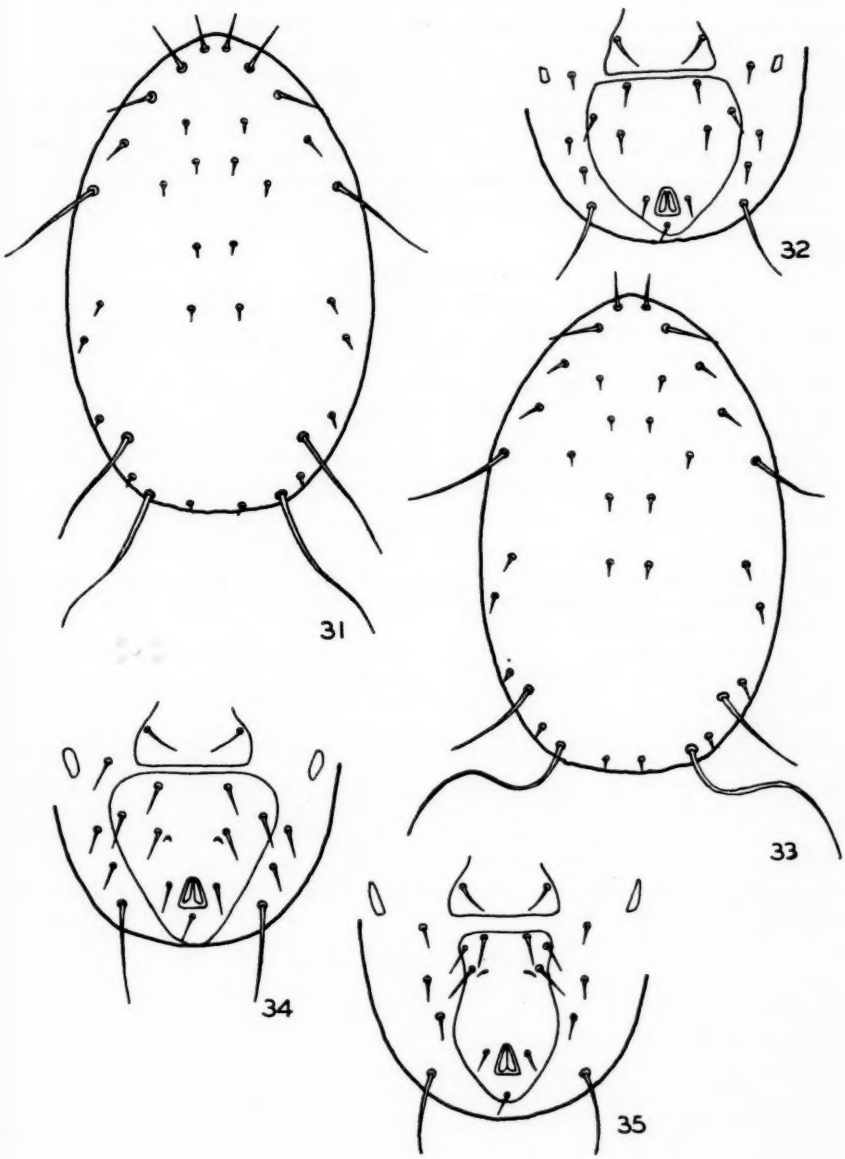
T. (A.) caudatus (Berlese)

Figs. 33-35

Three slides of this species, all from Java, are in the Berlese Collection. Two, numbers 133/42 and 133/41, are impossible to examine because the ringing material has obscured the mounts. Specimen 133/40, the type, is in poor condition and only the dorsal surface can be seen. The redescription was prepared from this specimen.

Female.—Dorsal shield smooth, with 17 pairs of setae: nine in the lateral, two in the median, and six in the dorsal rows (Fig. 33). All setae in dorsal rows minute, except D1. Setae L4, L9, and M2 moderately long (70, 90, and 280 μ respectively). Setae L2, L3, L5, and L6 of equal length, and minute. Seta L1 approximately half as long as L4. Base of seta M2 approximately halfway between bases of setae L7 and L8.

Ventral surface impossible to examine. I have seen specimens labelled *T. (A.) caudatus* in various collections, some of which have a triangular ventri-



Figs. 31-35. 31, *T.* (*A.*) *obtusus* (Berlese), dorsal shield; 32, *T.* (*A.*) *obtusus* (Berlese), posterior ventral surface; 33, *T.* (*A.*) *caudatus* (Berlese), dorsal shield; 34, *T.* (*A.*) *caudatus* (Berlese) ?, posterior ventral surface; 35, *T.* (*A.*) *caudatus* (Berlese) ?, posterior ventral surface.

anal shield with three pairs of setae in addition to the para-anals, and a pair of conspicuous pores (Fig. 34). On the other hand, specimens in the British Museum (Natural History), collected in Mauritius, have an oval ventri-anal shield with three pairs of setae in addition to the para-anals, situated on the anterior one third of the shield as in *T.* (*A.*) *finlandicus* (Oudemans), and with a pair of conspicuous pores (Fig. 35). In both forms, four pairs of setae surround the ventri-anal shield and a pair of parapodal plates is present. Berlese mentioned in his description of this species that the ventral surface was not seen and because the poor condition of the specimens in his collection prevents critical examination, statements on the identity of this species cannot be more than speculations.

Acknowledgments

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References

Berlese, A. 1914. Acari nuovi. *Redia* 10: 113-150.

Chant, D. A. 1955. Notes on mites of the genus *Typhlodromus* Scheuten, 1857 (Acarina: Laelaptidae), with descriptions of the males of some species and the female of a new species. *Canadian Ent.* 87: 496-503.

Chant, D. A. In preparation. Note on the status of some genera in the family Phytoseiidae (Acarina): Laelaptidae).

Cunliffe, F., and E. W. Baker. 1953. A guide to the predatory phytoseiid mites of the United States. *Pinellas Biol. Lab. Pub.* No. 1.

Garman, P. 1948. Mite species from apple trees in Connecticut. *Connecticut Agr. Expt. Sta. Bull.* No. 520.

Koch, C. L. 1839. Deutschlands Crustaceen, Myriapoden und Arachniden. Regensburg.

Nesbitt, H. H. J. 1951. A taxonomic study of the Phytoseiinae (Family Laelaptidae) predacious upon Tetranychidae of economic importance. *Zool. Verh.* 12.

Scheuten, A. 1857. Einiges über Milben. *Arch. Naturgesch.* 23: 104-112.

Womersley, H. 1954. Species of the subfamily Phytoseiinae (Acarina: Laelaptidae) from Australia. *Australian J. Zool.* 2: 169-191.

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Notes on the Genus *Hystrichopsylla* Rothschild in the New World, with Descriptions of One New Species and Two New Subspecies (Siphonaptera: Hystrichopsyllidae)[1]

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The genus *Hystrichopsylla* is Holarctic in distribution; its species include the largest known fleas. Only a few of the species exhibit marked host preferences. *H. talpae* (Curtis), the type of the genus, occurs through much of Europe and Asia, where the favoured hosts are insectivores and small rodents. It differs from all other known species chiefly in the presence of true combs of long, pigmented spines on abdominal terga II to IV (Fig. 1). Because of the differences, Ioff and Scalon (1950, *in* Ioff and Scalon *et al.*, p. 273) proposed the subgenus *Hystroceras* (type, *H. satunini* Wagn.) to contain a group of Palaearctic species (*satunini* Wagn., *microti* Scalon, and *nicolai* Scalon) that have the abdominal combs reduced to series of apical spinelets (Fig. 2); this taxon would include all the known Nearctic species of *Hystrichopsylla*. Ioff and Scalon considered *Typhloceras* Wagn., known only from the Palaearctic region, a third subgenus, but this interpretation will probably not be generally followed.

There has been considerable confusion in the taxonomy of the Nearctic species of *Hystrichopsylla*. This paper clarifies some of the confusion, although available material is inadequate for an exhaustive revision.

In the New World, fleas of the genus *Hystrichopsylla*, especially males, are usually rather scarce in collections, probably because the fleas are chiefly nest-dwellers, seldom travelling on their hosts. However, as it is unusual to secure adequate series even from nests, it may be that these large fleas are genuinely rare, or at least sporadic in distribution. Most of the specimens on which the present study was based were collected from host animals, usually as singletons or in twos or threes. In the few cases in which long series of specimens of a species were available for study, most of the characters used in taxonomy were rather variable, an occasional individual being widely aberrant. It was sometimes difficult, therefore, to evaluate the taxonomic status of single specimens or short series, especially those from widely separated localities. This was particularly true of some specimens referable to the *dippiei* complex. The writer suspects that several taxonomic entities additional to those that he recognizes at this time may be represented in his study material, but hesitates to propose names for them; investigations with longer series should eventually solve some of the remaining problems.

Aside from the problematical species *Pulex gigas* Kirby, 1837, which probably belongs to *Hystrichopsylla* (e.g., Jordan, 1929) but which cannot be equated with any of the known forms at this time, nine New World species of this genus have been proposed. In the writer's opinion, two if not three of these are synonyms or, at the most, subspecies of other described forms. Several of the valid species were inadequately described and require supplementary definition to distinguish them from other forms. In the present paper the writer attempts to clarify the status of the described species, but his opinions on the synonymy of *H. mammoth* Chapin and *H. hubbardi* Augustson with *H. schefferi* Chapin, and the possible synonymy of *H. kris* Traub and Johnson with *H. orophila* Barrera, are frankly speculative, being based on the arguments

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presented rather than on an examination of types or adequate topotypical material.

The principal morphological criteria used in this paper for separating the species are structures of the male genitalia, especially of sternum IX. The female terminalia in general did not appear to offer reliable characters, although many female specimens could be identified by size, number of spines in the genal ctenidium, geographical location and host association. In other cases it was not practicable to assign names to females, especially if from areas from which males were not seen. The best criterion for identification of females of *Hystrichopsylla* spp. is association with male specimens.

The writer considers that it is not unusual for variants having anomalous spiniform setae or other "abnormalities" to occur in *Hystrichopsylla* spp. and, further, that undue reliance on unusual characters in single specimens has resulted in the proposal of three species in which the main diagnostic features are not typical of the populations they represent. One of these species, and possibly two, should be sunk in synonymy; the third name will stand (as a subspecies) but on the basis of other characters.

The principal difference is the presence of heavy spiniform setae on the male sternum VIII, a structure ordinarily vested only in thin, hairlike setae. *H. spinata* Holland was erected principally on such a character in a single male; subsequent material, apparently of this species, suggests that males do not ordinarily possess such setae. Furthermore, the writer has now seen a specimen of another species, *H. occidentalis* Holland, that has such spiniform setae on sternum VIII. He therefore questions the validity of *H. hubbardi* Augustson, based on a single pair of fleas from Coos County, Oregon, from *Aplodontia rufa*, and characterized principally by the presence of a group of spiniform setae on sternum VIII of the male. It seems highly probable that this specimen is simply a variant of *H. schefferi* Chapin, which was described from Washington, also from *Aplodontia* sp.

The writer considers that *Hystrichopsylla kris* Traub and Johnson, 1952, based on a single female from Mt. Tancitaro, Mexico, is probably conspecific with *H. orophila* Barrera, described earlier the same year from a single male from Mt. Popocatepetl, Mexico. In any case he suspects that the unusual position of the eighth spiracle of *kris* (lateral, instead of marginal, on the tergum) represents an abnormality. In *all known fleas* the spiracle of abdominal segment VIII is normally on the inner dorso-posterior margin of the tergum. The significance of its being in any other position on a single specimen should therefore be interpreted with extreme caution. There is in the Canadian National Collection of Insects a single male (from a long series) of *Ceratophyllus lari* Holland that has the spiracles opening laterally on tergum VIII; this is the only other such case known to the writer.

The writer recognizes nine Nearctic species and subspecies of *Hystrichopsylla*, including a new species and two new subspecies; they appear to fall into three natural groups that can be separated conveniently on the number of spines in the genal ctenidium, and the number of spiniform setae on sternum IX of

Figs. 1, 2. Abdominal terga II and III. 1, *Hystrichopsylla talpae*. 2, *H. dippiei dippiei* (Hanna, Alta.).

Figs. 3-6. Preantennal region of head of male. 3, *H. tahavuana* (Roan Mt., Tennessee). 4, *H. dippiei neotomae* (paratype; Berkeley, Cal.). 5, *H. linsdalei* (holotype). 6, *H. schefferi* (Coos Co., Oreg.).

Figs. 7-9. Surface markings of inner angle of sternum IX of male. 7, *H. d. dippiei* (Pincher Creek, Alta.). 8, *H. d. truncata* (Upton, Ut.). 9, *H. d. spinata* (holotype).

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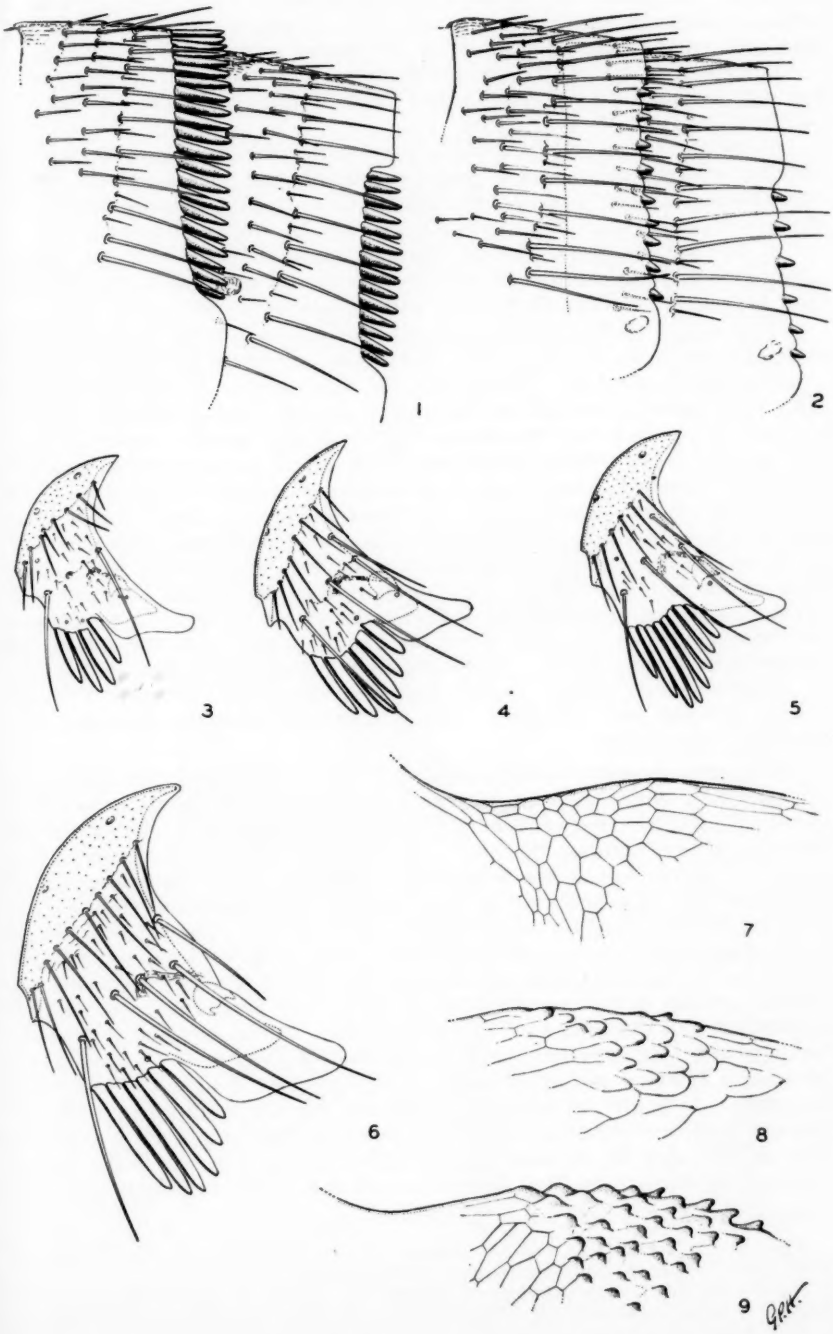

the males. Curiously, and apparently coincidentally, there appears to be a correlation between the number of genal spines and the number of major pairs of spiniforms on the male sternum IX in the species of each group.

1. *tahavuana* group. Genal ctenidium normally with four or five spines; apex of sternum IX with four or five pairs of spiniforms. One species: *H. tahavuana* Jordan.

2. *dippiei* group. Genal ctenidium normally with six spines; sternum IX with six or seven pairs of spiniforms. Six species and subspecies: *H. dippiei dippiei* Rothschild, *H. dippiei spinata* Holland, *H. dippiei neotomae* n. spp., *H. dippiei truncata* n. spp., *H. schefferi* Chapin, and *H. orophila* Barrera.

3. *occidentalis* group. Genal ctenidium with at least seven but usually eight or more spines; sternum IX usually with eight or more pairs of spiniforms. Two species: *H. occidentalis* Holland and *H. linsdalei* n. sp.

Taxonomically, the most difficult section of the genus is the *dippiei* complex of the *dippiei* group (i.e., the group of forms treated in this paper as subspecies of *H. dippiei* Rothschild). Geographically, the complex is represented from Alaska and British Columbia to Saskatchewan, and from California to New Mexico. These fleas may represent a single polytypic species or two or more such species. They exhibit considerable local as well as geographical variation so that differences discerned in scattered specimens and short series are difficult to interpret. In the present paper, the writer attempts to tread a conservative path in which he recognizes the more conspicuous segregates (four) as subspecies of one species, but frankly admits that future studies based on an abundance of material may indicate (a) that more than one species is represented, (b) that additional subspecies should be recognized, or (c) that the populations are connected by a complex system of clines so that even the subspecific interpretation is impractical. Little is to be gleaned from host associations; these fleas, though locally scarce, appear to occur on virtually all small rodents, although the Californian form is apparently strongly associated with woodrats, *Neotoma* sp.

As a starting point in evaluating the complex, it is clear that *dippiei* (as exemplified by specimens from Alberta) is readily separable from *spinata* (from Vancouver, B.C.) by the presence in the latter of a large patch of tubercles on the inner angle of sternum IX and the square, rather than oblique, apex of that sclerite. The differences are sufficiently strong to justify interpretation of *dippiei* and *spinata* as species if it were not that some specimens from the interior of British Columbia and various points in the United States exhibit intermediate stages between these extremes. There is no evidence yet that the extremes of *dippiei* and *spinata* grade smoothly from one to the other, but the presence of fleas in the intervening areas with a few tubercles on sternum IX suggests that this character is of subspecific rather than of specific value as was first supposed. For expediency this intermediary population of fleas (in which there are indications of further geographical variation) is described as a third subspecies. A fourth subspecies is proposed for the Californian form on *Neotoma* spp.; its tuberculate area is as strong as that of *spinata*, but, as the shape of the apex of sternum IX (expanded, and terminating obliquely) is practically uniform in the long series examined, it is assumed that this represents

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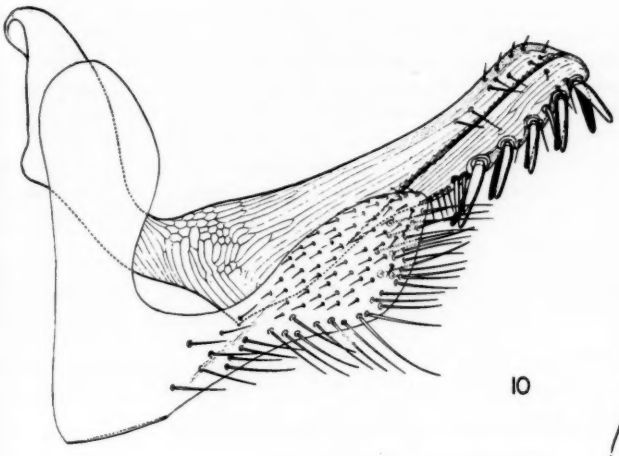
Figs. 10, 11. Sterna VIII and IX of male. 10, *Hystrichopsylla d. dippiei* (Pincher Creek, Alta.). 11, *H. d. neotomae* (paratype; Berkeley, Cal.).

Figs. 12-16. Apex of ventral arm of sternum IX. 12, *H. d. dippiei* (Hanna, Alta.). 13, *H. d. neotomae* (paratype). 14, *H. d. truncata* (holotype). 15, *H. d. spinata* (holotype). 16, *H. d. spinata* (topotype).



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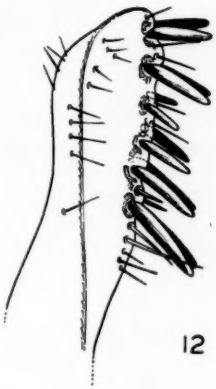

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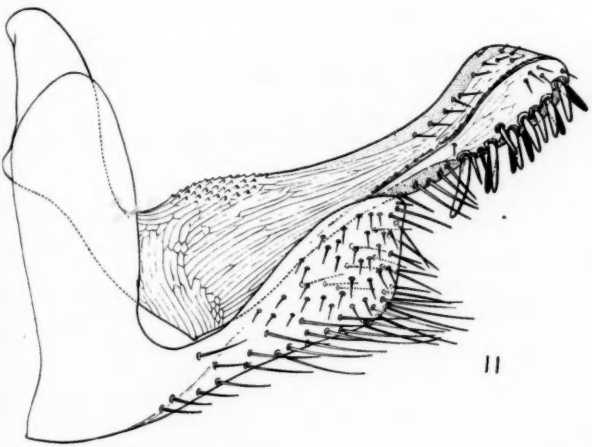

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16

a significant difference from *spinata*, in which sternum IX is parallel-sided and square-tipped in the few males available (cf. Figs. 11, 13, 15, and 16).

The *dippiei* complex is partly sympatric with the *occidentalis* group; it is notable that in British Columbia the representatives of the two groups appear to occur on a wide variety of hosts, sometimes, indeed, on the same species (although there are no records available at present of more than one species of *Hystrichopsylla* occurring on the one host-individual), whereas in California the representative of one (*H. dippiei neotomae*) is strongly associated with *Neotoma* sp. but that of the other (*H. linsdalei*) apparently is virtually restricted to mice of the genera *Microtus* and *Peromyscus*.

In the present paper no attempt is made to list all references to the various species, although original descriptions, and some of the more important subsequent papers, especially those containing descriptive matter or significant records, are cited.

The localities and hosts listed are restricted to those represented by the specimens examined in the present study.

Key to the Nearctic Species of *Hystrichopsylla*

(emphasizing male sex characters)

1. Genal ctenidium of 4 or 5 spines (Fig. 3); sternum IX with dorsal apical lobe and about 5 spiniforms or pairs of spiniforms (Fig. 20). Eastern temperate North America only ..... *tahavuana* Jordan
   Genal ctenidium of more than 5 spines; sternum IX without apical lobe and with more than 5 spiniforms or pairs of spiniforms. Western Nearctic, and Mexico 2
2. Genal ctenidium typically of 6 spines (Figs. 4, 6) 3
   Genal ctenidium typically of 8 or more spines (Fig. 5) 8
3. Very large (♂, 5-7 mm.; ♀ 7-9 mm.); four antepygidial setae in either sex. Normally occurring on *Aplodontia rufa* or its predators ..... *schefferi* Chapin
   Smaller (*orophila* from Mexico perhaps as large); three antepygidial setae; not associated with *Aplodontia* 4
4. Sternum IX tapering apically. Movable and fixed processes of equal length. Known only from Mexico ..... *orophila* Barrera
   Sternum IX not tapering. Movable process exceeding fixed process. North of Mexico ..... *dippiei* ssp. 5
5. Inner angle of sternum IX tuberculate (Figs. 8, 9, 11); apex of sternum IX square or oblique 6
   Inner angle of sternum IX reticulate, not tuberculate; apex of sternum IX normally oblique (Figs. 7, 10). Great Plains and adjacent Rocky Mountains ..... *dippiei dippiei* Rothschild
6. Tubercles of sternum IX few; apex of ventral arm of sternum IX square, the dorsal and ventral margin subparallel (Figs. 8, 14). Interior of British Columbia; extending to Utah and New Mexico ..... *dippiei truncata* n. ssp.
   Tubercles of sternum IX many; apex square if margins subparallel, or oblique if the sclerite is dilated apically 7
7. Margins of ventral arm of sternum IX subparallel; apex square (Figs. 15, 16). Known only from western British Columbia ..... *dippiei spinata* Holland
   Ventral arm dilated apically; apical margin oblique (Figs. 11, 13). Known only from California, on *Neotoma* sp. ..... *dippiei neotomae* n. ssp.
8. Movable process slightly exceeding fixed process (Fig. 26); ventral arm of sternum IX very broad, its margin tapering apically (Figs. 18, 21) ..... *linsdalei* n. sp.
   Movable process not, or barely, exceeding fixed process (Fig. 27); ventral arm of sternum IX narrow, its margins subparallel (Fig. 19) ..... *occidentalis* Holland

Hystrichopsylla tahavuana Jordan

Figs, 3, 20

Hystrichopsylla gigas tahavuana Jordan, 1929, *Nov. Zool.* 35: 173-174; fig. 8.
Hystrichopsylla tahavuana, Holland, 1949, *Canada Dept. Agr. Tech. Bull.* 70: 76; figs. 45, 46; map 5.

H. tahavuana, the most distinctive species of the genus in the Nearctic region, was described from the Adirondack Mountains, New York, from speci-

mens collected on shrews, *Blarina brevicauda* (Say), and meadow voles, *Microtus pennsylvanicus* (Ord). It appears to be restricted to areas of eastern North America characterized by climax deciduous hardwood forest, where hosts are a variety of insectivores and small rodents. The usual number of genal spines is five although individuals with four (Fig. 3) are not uncommon. The male genitalia (Fig. 20) are strikingly different from those of all other Nearctic species, although they resemble those of *H. microti* Scalon from Korea and other parts of eastern Asia, which also has five genal spines and which also may be associated with climax hardwood forest.

Localities.—ONTARIO: Brule Lake, Algonquin Park, 3 ♂♂, 2 ♀♀; Pt. Abino, Welland Co., 1 ♂; QUEBEC: Lac Mondor, Ste. Flore, 1 ♀; PENNSYLVANIA: Erie Co., 3 ♂♂, 1 ♀; Jefferson Co., 1 ♂; Warren Co., 3 ♀♀; Potter Co., 1 ♀; TENNESSEE: Carver's Gap, Roan Mt., 1 ♂.

Hosts.—*Blarina brevicauda* (Say), 5 ♂♂, 6 ♀♀; *Parascalops breweri* (Bachman), 3 ♂♂, 2 ♀♀; *Pitymys pinetorum* (LeConte), 1 ♀.

***Hystrichopsylla dippiei dippiei* Rothschild**

Figs. 2, 10, 12, 22

Hystrichopsylla dippiei Rothschild, 1902 *Ent. Rec. and J. Var.* 14: 63; pl. II, fig. 2. Jordan, 1929, *Nov. Zool.* 35: 174. Holland, 1949, *Canada Dept. Agr. Tech. Bull.* 70: 75; figs. 42-44, map 6.

Rothschild described the species from a male (which he figured) from Alberta, from *Mustela frenata longicauda* Bonaparte (=*Putorius longicaudatus*), and a female from Chilliwack, B.C., from *Mustela vison energumenos* (Bangs) (=*Lutreola energamos*). No type was specifically designated. As suspected earlier (Holland, 1949, p. 75), the two specimens are of different species, the Chilliwack specimen being referable to a species now known as *H. occidentalis* Holland. To obviate any possible future difficulty, the male from Alberta is hereby selected as lectotype. This specimen, examined at the Zoological Museum, Tring, is labelled "*Hystrichopsylla dippiei* Roths. Alberta Canada 21 Sept. 1900, ♂ type. From *Putorius longicaudatus* (G. F. Dippie)". It was probably collected at or near Calgary, but as this locality is not specifically indicated on the label the writer hereby selects Calgary, Alberta, as the "restricted locality" in accordance with item 31(1) of the *Copenhagen Decisions on Zoological Nomenclature* (1953, pp. 26-27). Four additional males at Tring, labelled "Calgary, Alberta", agree well with the lectotype.

The names *H. dippiei* and *H. gigas dippiei* have been applied widely, and many times incorrectly, to material from many parts of western North America. Examination of all the available material indicated that a complex of forms exists that are best interpreted at this time as a series of subspecies. Of these the nominate subspecies *H. dippiei dippiei* occurs only in the Great Plains region of Canada and the midwestern United States, where the usual hosts are species of *Citellus*.

H. dippiei dippiei, as understood from the lectotype and a small series of near-topotypical males, is distinguished from other members of the complex chiefly by features of sternum IX. In this form, the ventral arm of the sternum is more or less parallel-sided, and cut off obliquely at the apex (Figs. 10, 12). There are usually about six major pairs of very heavy spiniform setae, and often a few smaller spiniforms. The surface of the sclerite inside the angle at the junction of the dorsal and ventral arms is smooth, with faint reticulate surface markings in roughly hexagonal form. The marked-off divisions are not raised up as conspicuous tubercles.

Localities.—ALBERTA: Pincher Creek, 1 ♂; 45 miles W. of Calgary, 1 ♀;

Hanna, 5 ♂ ♂, 1 ♀; Stanmore, 4 ♂ ♂; Milk River, 1 ♀; Cereal, 1 ♀; Elkwater, 1 ♀; Boom Lk. trail, Banff, 2 ♂ ♂, 3 ♀ ♀; Seebe, 1 ♂; SASKATCHEWAN: Rock Glen, 2 ♂ ♂, 1 ♀; Masefield, 1 ♀; Climax, 1 ♀; MONTANA: Beaverhead Co., 1 ♂; Glacier Co., 1 ♂, 7 ♀ ♀; Powderville, 1 ♀; W. fork Bitterroot R., 1 ♀; Gallatin Co., 5 ♀ ♀; Victor, 1 ♀; Toole Co., 1 ♀; NORTH DAKOTA: Rolette Co., 1 ♀; SOUTH DAKOTA: Custer Co., 2 ♀ ♀; WYOMING: Albany Co., 1 ♂, 2 ♀ ♀; Park Co., 1 ♂, 2 ♀ ♀; Lincoln Co., 2 ♀ ♀.

Hosts.—*Mustela frenata* Lichtenstein, 1 ♂; *Canis latrans* Say 1 ♀; *Marmota flaviventris* (Audubon and Bachman), 1 ♀; *Citellus columbianus* (Ord), 1 ♂, 6 ♀ ♀; *C. richardsoni* (Sabine), 12 ♂ ♂, 9 ♀ ♀; *C. elegans* (Kennicott), 2 ♀ ♀; *C. armatus* (Kennicott), 4 ♀ ♀; *Cynonys leucurus* Merriam, 1 ♂, 1 ♀; *Eutamias* spp., 4 ♀ ♀; *Tamiasciurus hudsonicus* (Erxleben), 2 ♀ ♀; *Peromyscus maniculatus osgoodi* Mearns, 1 ♂, 1 ♀; *Microtus pennsylvanicus* (Ord), 2 ♂ ♂, 3 ♀ ♀; *Microtus* sp., 1 ♀; *Zapus princeps minor* Preble, 1 ♀; *Ochotona princeps* (Richardson), 1 ♀.

Hystrichopsylla dippiei spinata Holland, new combination

Figs. 9, 15, 16, 24

Hystrichopsylla spinata Holland, 1949, *Canada Dept. Agr. Tech. Bull.* 70: 77; figs. 50-52; map 6.

The species was described from one male and three females, from Vancouver, British Columbia, on spotted skunk, *Spilogale gracilis olympica* (Elliot). The principal distinguishing feature was a series of heavy spiniform setae on sternum VIII, a structure normally having only thin setae. For reasons given earlier in this paper, the writer now considers this condition to be abnormal. Two additional males (one a topotype, also from *Spilogale* sp.) from British Columbia are now available, and agree with the holotype of *spinata* in all essentials except that they lack the spiniforms.

However, the name *spinata* will stand, because the three available males have striking characters distinguishing them from *dippiei*. The ventral arm of sternum IX is roughly parallel-sided, or very slightly dilated apically, and almost perfectly square across the apex (Figs. 15, 16). The surface of sternum IX near the junction of the dorsal and ventral arms is marked in divisions of which about 40 are produced as conspicuous tubercles (Fig. 9). The spiniforms of sternum IX are slightly more numerous and somewhat shorter than in *H. dippiei dippiei;* the longest of them is not equal to the breadth of the sternum near its apex, whereas in *H. d. dippiei* several of the spiniforms may attain or exceed this breadth.

Localities.—BRITISH COLUMBIA: Vancouver, 2 ♂ ♂, 4 ♀ ♀; Williams Lake, 1 ♂, 1 ♀.

Hosts.—*Spilogale gracilis olympica* (Elliot), 2 ♂ ♂, 4 ♀ ♀, *Citellus columbianus* (Ord), 1 ♂; *Peromyscus maniculatus* (Wagner), 1 ♀.

Hystrichopsylla dippiei neotomae n. ssp.

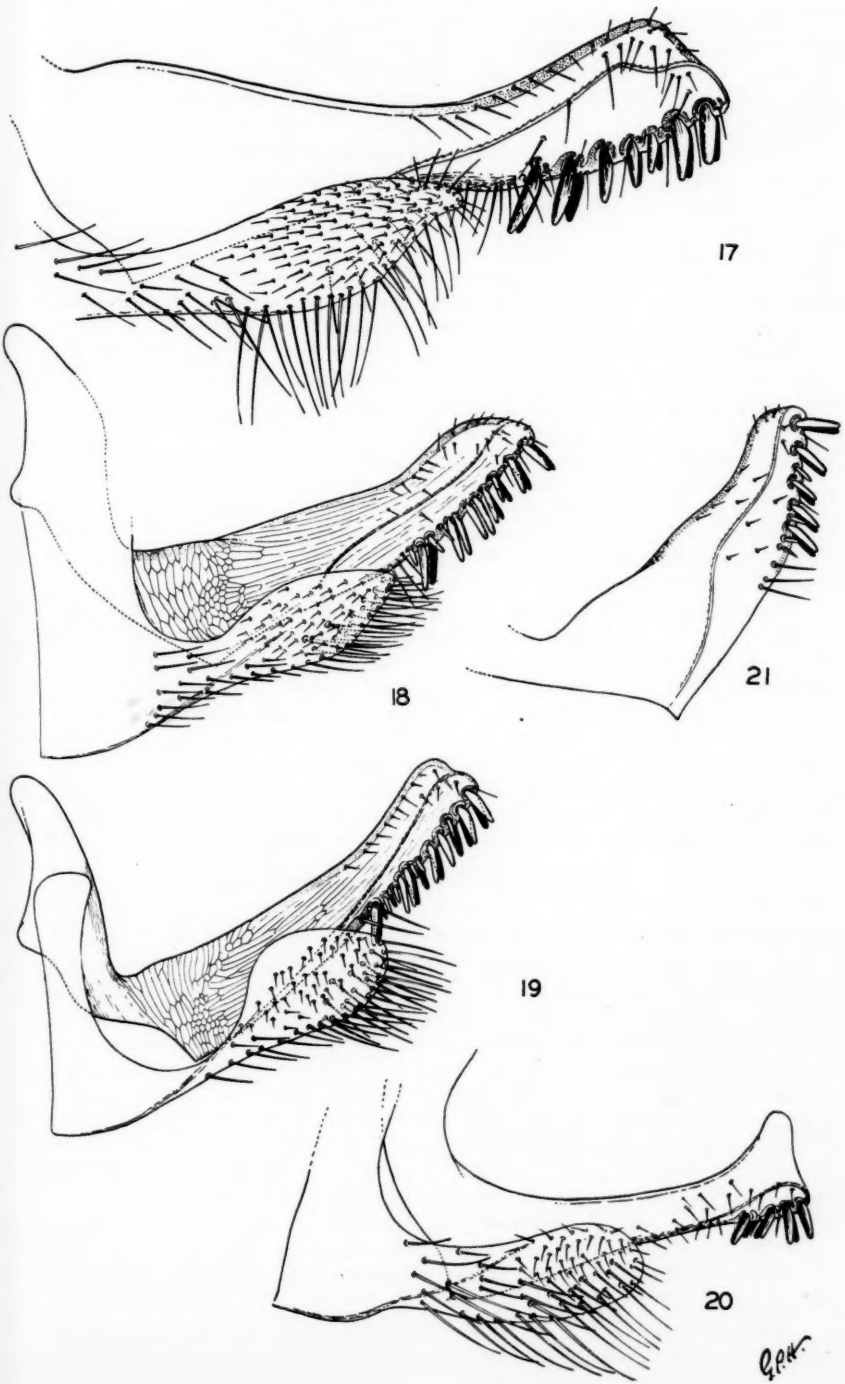
Figs. 4, 11, 13, 25, 28

Agreeing with *H. d. dippiei* in almost all respects of structure and chaetotaxy, but distinguished from this and from other subspecies by details of the male genitalia. Nearest *H. dippiei spinata*, from which it may be distinguished by the ventral arm of sternum IX of the male.

The following description is based principally on a series of 12 males and 10 females bearing virtually identical collection data.

Figs. 17-20. Sterna VIII and IX of male. 17, *Hystrichopsylla schefferi* (Tacoma, Wash.). 18, *H. linsdalei* (Los Angeles, Cal.). 19, *H. occidentalis* (Vancouver, B.C.). 20, *H. tahavuana* (Erie Co., Pa.).

Fig. 21. Ventral arm of sternum IX of *H. linsdalei* (holotype).


17
18
21
19
20

Male.—Genal ctenidium of 6 spines (Fig. 4) except in one individual that has an additional small spine on one side. Pronotal ctenidium usually with 16 or 17 (15-18) spines per side. Abdominal terga with apical spinelets as follows: II, 8 or 9, rarely 10; III, 7 or 8, less often, 6 or 9; IV, 6 (5-7); V, 0, rarely 1.

Three antepygidial setae. Movable process of clasper broad and extending well beyond fixed process (Fig. 24). Sternum VIII usually somewhat strongly pointed, rather than rounded, apically. Sternum IX with 30-40 tubercles on the dorsal hump of the ventral arm, near where it joins the dorsal arm (Fig. 11). Ventral arm distinctly dilated apically, with the apical margin oblique (cf. *H. d. spinata*). About 16 (13-20) apical spiniform setae, usually arranged in 6 or 7 pairs, with smaller spiniforms between; spiniforms appearing small proportionately because of the expanded apex of the sclerite.

Female.—Genal ctenidium of 6 spines (one with 7 on one side, and another with 5). Pronotal ctenidium of 18 (17-19) spines per side. Abdominal terga with spinelets as follows: II, 8(7-11); III, 6 or 7(5-10); IV, 4(3-6).

Three antepygidial setae. Two large, equal-sized, spermathecae. Sternum VII with shallow but distinct sinus, ventral lobe extending caudad (Fig. 28).

Size (mounted specimens): ♂, 4.5 mm. (3.9-4.9); ♀, 6.1mm. (5.5-6.5).

Holotype.—♂, Strawberry Canyon, Berkeley, Alameda Co., California, February 26, 1954, collected from nest of *Neotoma* sp. by Messrs. E. Mendez and G. Loshbaugh; No. 6546 in the Canadian National Collection of Insects, Ottawa.

Allotype.—♀, same data.

Paratypes.—29 ♂ ♂ and 26 ♀ ♀, all from California, as follows: same data as holotype and allotype, 10 ♂ ♂, 9 ♀ ♀; same locality and host, 23.XII.52, 3 ♀ ♀ (R. Lee and V. J. Tipton); same locality, 17.IV.54, 1 ♂ (Mendez and Loshbaugh); Berkeley, 10.XII.28, ex nest of *Neotoma fuscipes* Baird, 4 ♂ ♂, 7 ♀ ♀ (G. Loshbaugh); Berkeley 25.IV.43, ex nest of *Neotoma fuscipes*, 1 ♂, 1 ♀ (P. Q. Tomich); Alameda Co., 2.VII.36, ex *Neotoma* sp., 1 ♂; Boulder Creek, various dates, ex nests of *Neotoma* sp., 7 ♂ ♂, 1 ♀; Gasquet, 30.XII.41, ex *Peromyscus maniculatus rubidus* (Osgood), 1 ♂, 1 ♀ (C. A. Hubbard); Monterey Co., 23.XII.53, ex nest of *Neotoma* sp., 4 ♂ ♂, 2 ♀ ♀ (V. D. Roth); La Honda, San Mateo Co., 26.V.49, ex nest of *Neotoma* sp., 2 ♀ ♀ (F. M. Prince).

***Hystrichopsylla dippiei truncata* n. ssp.**

Figs. 8, 14, 23

Hystrichopsylla dippiei Holland, 1949, *Canada Dept. Agr. Tech. Bull.* 70: 75 (*in part*).

In 1949, writing of *H. dippiei*, the author stated: "Alberta and Saskatchewan specimens all have sternum IX cut off at a blunt angle . . . whereas British Columbia specimens have this structure nearly square at the tip." Subsequent collections substantiate this assertion, and the writer now considers that it is advisable to recognize as a further subspecies a form of *Hystrichopsylla* from the interior of British Columbia that has characters intermediate between those of *H. d. dippiei* to the east and *H. d. spinata* to the west. It appears convenient at this time to refer certain specimens from Utah and New Mexico to this form, although the limited material available suggests, as mentioned earlier, that further geographical variation may eventually be demonstrated when longer series become available. This is suggested even for some of the populations occurring in British Columbia. Because of these difficulties, the type series is restricted to a rather small group of specimens collected in the Okanagan Valley of the interior of the province.

Male.—Distinguished from other subspecies only by the ventral arm of sternum IX, which is parallel-sided and nearly always square apically (Fig. 14)

and which nearly always has at least some of the surface divisions near the angle of the sternum raised as tubercles, though not so many as in *H. d. spinata* (cf. Figs. 8, 9).

Female.—Not reliably separable from those of other subspecies.

Holotype.—♂, Okanagan Landing, British Columbia, September 15, 1950, collected from *Peromyscus maniculatus artemisiae* (Rhoads) by J. D. Gregson; No. 6547 in the Canadian National Collection of Insects, Ottawa.

Allotype.—♀, Terrace Mountain, near Vernon, B.C., October 18, 1946, collected from *Clethrionomys gapperi saturatus* Rhoads by J. D. Gregson.

Paratypes.—4 ♂ ♂, all from British Columbia, as follows: Okanagan Landing, 15.IX.50 ex *Microtus pennsylyvanicus drummondi* (Audubon and Bachman), 1 ♂ (J.D.G.); Kelowna, 8.IV.40, ex burrow of *Citellus columbianus* (Ord), 1 ♂ (G. P. Holland); Kelowna, 11.V.44, ex *Peromyscus m. artemisiae*, 1 ♂ (G.P.H.); 13 miles S.E. of Kelowna, 10.IV.40, ex *C. columbianus* (J. B. Poole), 1 ♂.

Additional material, provisionally considered as of this subspecies, is recorded below.

Localities.—British Columbia: Rayleigh, 3 ♂ ♂, 1 ♀; Kamloops, 5 ♀ ♀; Kinbasket Lake, 1 ♀; Revelstoke, 1 ♀; Inonoaklin, Monashee Pass, 1 ♂; Field, 1 ♂, 1 ♀; Kimberley, 1 ♂: Idaho: Bear Lake Co., 1 ♂; Wyoming: Yellowstone Nat. Pk., 1 ♂; Utah: Monte Cristo, Rich Co., 3 ♂ ♂; Mt. Pleasant, San Pete Co., 2 ♂ ♂; Manti Nat. Forest, 1 ♀; Aspen Grove, 1 ♂, 1 ♀; Upton, 1 ♂; Iron Co., 3 ♀ ♀; Lake Creek, 2 ♀ ♀; Provo, 2 ♀ ♀ ;New Mexico: Pinos Altos, Grant Co., 1 ♂; Catron Co., 7900′, 2 ♂ ♂, 1 ♀; Sante Fe, 2 ♂ ♂, 4 ♀ ♀; San Miguel Co., 2 ♂ ♂, 3 ♀ ♀; 25 miles E. of Albuquerque, 1 ♂, 2 ♀ ♀.

Hosts.—*Sorex* sp., 1 ♂; *Mustela erminea* L,. 1 ♀; *Marmota* sp., 1 ♀; *Citellus lateralis* (Say), 1 ♂, 2 ♀ ♀; *C. columbianus* (Ord), 1 ♂; *C. armatus* (Kennicott), 5 ♂ ♂, 3 ♀ ♀; *Eutamias quadrivittatus* (Say), .1 ♂, 3 ♀ ♀; *Eutamias* sp., 1 ♀; *Tamiasciurus hudsonicus* (Erxleben),, 2 ♂ ♂, 1 ♀; *Peromyscus maniculatus* (Wagner), 4 ♂ ♂, 6 ♀ ♀; *P. boylii* (Baird), 1 ♂; *P. nasutus* (Allen), 1 ♀; *Neotoma* spp., 1 ♂, 2 ♀ ♀; *Microtus montanus canescens* Bailey, 1 ♂, 1 ♀; *M. longicaudus* (Merriam), 3 ♂ ♂; *Microtus* sp., 2 ♂ ♂, 1 ♀; *Clethrionomys gapperi* (Vigors), 1 ♀; *Zapus* sp., 1 ♀.

Hystrichopsylla dippiei subspecies

Among the material available to the writer at this time are a number of female specimens belonging to the *dippiei* complex. In the absence of accompanying males it is not possible to place these with certainty. Some of the more interesting records are listed hereunder to demonstrate further the geographical range of the complex, as well as some of the hosts.

Localitis.—Alaska: Ketchikan, 1 ♀; British Columbia: Dempsey Lake, Cariboo District, 1 ♀; Cowichan Lake, 2 ♀ ♀; Oregon: Josephine Co., 2 ♀ ♀; Idaho: Bonneville Co., 1 ♀; Boundary Co., 1 ♀; Arizona: Graham Co., 1 ♀; Colorado: Lake Co., 2 ♀ ♀; Routt Co., 3 ♀ ♀; Antonito, 2 ♀ ♀.

Hosts.—*Scapanus* sp., *Procyon lotor* ssp., *Martes caurina vancouverensis* G. and D., *Mustela erminea* (L.), dog, "ground bear", *Citellus lateralis* (Say), *C. columbianus* (Ord), *C. elegans* (Kennicott), *C. armatus* (Kennicott), *Tamiasciurus hudsonicus* (Erxleben), *T. douglasii* (Bachman), *Neotoma mexicana* Baird, and *N. cinerea* (Ord).

Hystrichopsylla schefferi Chapin

Figs. 6, 17

Hystrichopsylla schefferi Chapin, 1919, *Bull. Brooklyn Ent. Soc.* 14: 50-52. Hubbard, 1947, Fleas of Western North America, pp. 359-362; figs. Holland 1949, *Canada Dept. Agr. Tech. Bull.* 70: 78; figs. 53, 54; map 6.

Hystrichopsylla mammoth Chapin, 1921, *Proc. Ent. Soc. Washington* 23: 25-27. Jordan, 1937, *Nov. Zool.* 40: 270-271; fig. 56. *New synonymy.*

Hystrichopsylla hubbardi Augustson, *Bull. So. Calif. Acad. Sci.* 52: 119-122; 2 figs. *New synonymy.*

H. schefferi was described from a single female collected at Puyallup, Washington, from a nest of *Aplodontia rufa* (Rafinesque), the sewellel or mountain beaver, which is apparently the true host. *H. mammoth* was described from specimens of both sexes from Mammoth, Mono County, California, on *Aplodontia rufa*, and from Yosemite National Park, probably from *Aplodontia* sp. Hubbard (1947) has tentatively allowed *mammoth* to stand as a subspecies of *schefferi*, but the author considers that it might just as well be regarded a synonym until the question can be properly evaluated by comparison of adequate population samples.

H. hubbardi, also from *Aplodontia rufa* and from the State of Washington, is considered a further synonym of *schefferi* for reasons given earlier in this paper.

H. schefferi is the largest known species of *Hystrichopsylla* and is possibly the world's largest flea. Specimens vary in size, but the writer has seen females that exceed 9 mm. in length. Hubbard has probably collected more specimens of this species than anyone else, and lists it from many localities in Washington, Oregon, and California. Its geographical range probably coincides with that of the favoured host, *Aplodontia rufa*.

Localities.—BRITISH COLUMBIA: Huntingdon, 1 ♂; Cultus Lake, 2 ♂ ♂, 1 ♀; WASHINGTON: Tacoma, 2 ♂ ♂; Seattle, 2 ♂ ♂, 2 ♀ ♀; Bellevue, 1 ♂; OREGON: Clastrop Co., 1 ♂, 5 ♀ ♀; Larch Mt., 1 ♀; Cannon Beach, Tillamook Co., 1 ♂, 1 ♀; Charleston, Coos Co., 1 ♂, 1 ♀ (virtual topotypes of "*H. hubbardi*"); CALIFORNIA: Smith River, Del Norte Co., 1 ♀.

Hosts.—*Mustela vison* Schreber, 2 ♂ ♂, 1 ♀; *Spilogale gracilis* Merriam, 2 ♂ ♂, 1 ♀; *Aplodontia rufa* (Rafinesque), 7 ♂ ♂, 10 ♀ ♀.

Hystrichopsylla orophila Barrera

Hystrichopsylla orophila Barrera, 1952 (May 30), *Ciencia* 12: 39-42; 3 figs.

Hystrichopsylla kris Traub and Johnson, 1952 (December 10), *Amer. Mus. Novit.* No. 1598, pp. 12-17; figs. 15-20. *Probable synonym.*

H. orophila and *H. kris* were both described from the mountains of Mexico, the first from a single male and the second from a single female. The specimen of *H. orophila* was collected on Mt. Popocatepetl, at 3100 metres, on a mouse, *Microtus mexicanus* Saussure, and the unique female of *kris* was collected about 240 miles away on Mt. Tancitaro, Michoacan, on *Neotomodon alstoni* Merriam. Both specimens are very large, perhaps equalling males and females of *H. schefferi*, and each bears a genal ctenidium of six spines. The possibility of synonymy seems fairly strong, but a firm decision must await future collections.

As mentioned earlier, the unusual eighth spiracle of *H. kris* is probably abnormal.

Hystrichopsylla occidentalis Holland

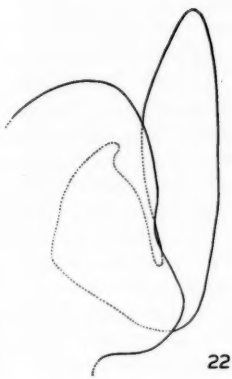
Figs. 19, 27

Hystrichopsylla occidentalis Holland, 1949, *Canada Dept. Agr. Tech. Bull.* 70: 76-77; figs. 47-49; map 6.

Hystrichopsylla gigas dippiei, Hubbard, 1947, Fleas of Western North America, pp. 357-359; figs. (*In part*).

Figs. 22-27. Clasper processes (setae omitted) of male. 22, *Hystrichopsylla d. dippiei* (Hanna, Alta.). 23, *H. d. truncata* (holotype). 24, *H. d. spinata* (topotype). 25, *H. d. neotomae* (paratype; Berkeley, Calif.). 26, *H. linsdalei* (holotype). 27, *H. occidentalis* (Vancouver, B.C.).

Figs. 28, 29. Sternum VII and spermathecae of female. 28, *H. d. neotomae* (paratype; Berkeley, Calif.). 29, *H. linsdalei* (paratype; Berkeley Hills, Calif.).



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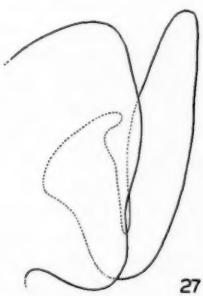

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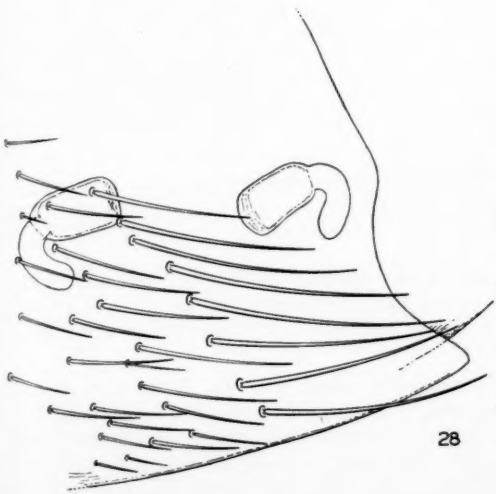

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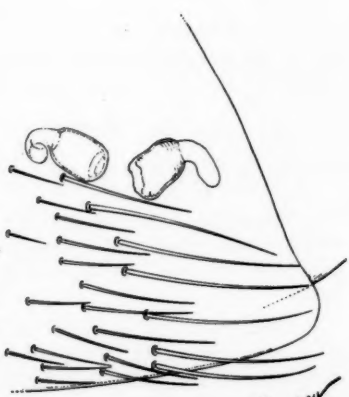

29

H. occidentalis, the smallest species of the genus in the Nearctic region, was described from Mt. Seymour and other localities in British Columbia. It occurs on a number of insectivores and small rodents of which the most frequent, perhaps, is the red-backed vole, *Clethrionomys* sp. *H. occidentalis* is readily distinguished in both sexes from all previously described species by the larger number of spines in the genal ctenidium. The usual number is eight, although specimens with seven to eleven spines have been seen. The male genitalia differ in the approximate equality in length of the fixed and movable processes, a condition otherwise found only in *H. orophila*, and in the shape and armature of the ventral arm of sternum IX. This arm (Fig. 19) is relatively slender, parallel-sided, square-tipped, and armed with a long series of short, pigmented spines that are not so noticeably arranged in pairs as in other species.

Recent collections reveal that *H. occidentalis* occurs from Alaska to California in damp coniferous forests, sometimes at high altitude. Many of Hubbard's (1947) records of "*H. gigas dippiei*" from Washington and Oregon are referable to this species. There is considerable individual variation but no firm evidence of geographical variation that warrants nomenclatorial recognition at this time.

Localities.—ALASKA: Seward, 2 ♀ ♀; Valdez, 1 ♂; Skwentna, 1 ♂, 1 ♀; Anchorage, 1 ♂, 4 ♀ ♀; Prince of Wales Island, 1 ♀; Peters Creek, 1 ♀; Juneau, 2 ♂ ♂; BRITISH COLUMBIA: Kungnit Is., Q.C.I., 2 ♀ ♀; Lanz Is., 1 ♀; Somerville Is., 1 ♀; S. Pender Is., 1 ♀; Metlakatla, 2 ♂ ♂, 1 ♀; Victoria, 1 ♀; Mt. Seymour, 1 ♂, 1 ♀; Vancouver, 12 ♂ ♂, 10 ♀ ♀; Gleneagles, 1 ♀; Mission, 1 ♂, 2 ♀ ♀; Harrison Bay, 1 ♀; Silver Creek, 1 ♂, 1 ♀; Hope, 1 ♀; Allison Pass, 1 ♀; Manning Pk., 1 ♂, 2 ♀ ♀; Raft Mt., 1 ♂; Drifwood R., 1 ♂; Mt. Revelstoke, 2 ♀ ♀; Kinbasket Lake, 1 ♀; WASHINGTON: Skagit Co., 1 ♂, 1 ♀; Tacoma, 2 ♂ ♂; Seattle, 1 ♂ (spines on st. VIII); West Post, 1 ♀; OREGON: *Portland*, 1 ♀; Yamhill Co., 1 ♂, 1 ♀; Tigard, Washington Co., 4 ♂ ♂, 1 ♀; Gaston, 3 ♂ ♂, 2 ♀ ♀; CALIFORNIA: Quincy, Plumas Co., 8 ♂ ♂, 4 ♀ ♀.

Hosts.— *Scapanus orarius schefferi* Jackson, 1 ♂; *Neurotrichus gibbsii* 6 ♂ ♂, 4 ♀ ♀; *Sorex* sp., 1 ♂; *S. obscurus* Merriam, 1 ♀; *S. trowbridgii* Baird, 1 ♂; *Tamiasciurus douglasii* (Bachman), 1 ♂, 1 ♀; *Peromyscus maniculatus* (Wagner), 10 ♂ ♂, 13 ♀ ♀; *Phenacomys intermedius* Merriam, 1 ♂; *Clethrionomys gapperi* (Vigors), 3 ♂ ♂, 6 ♀ ♀; *C. californicus* Merriam, 2 ♂ ♂, 1 ♀; *C. rutilus dawsoni* Merriam, 2 ♂, 4 ♀ ♀; *Microtus* sp., 1 ♂, 2 ♀ ♀; *M. oeconomus* (Pallas), 2 ♀ ♀; *M. townsendi* (Bachman), 5 ♂ ♂, 3 ♀ ♀; *M. longicaudus* (Merriam), 2 ♀ ♀; *M. oregoni serpens* Merriam, 10 ♂ ♂, 7 ♀ ♀; *Rattus norvegicus* (Erxleben), 4 ♂ ♂, 2 ♀ ♀; *R. rattus* L., 3 ♀ ♀.

***Hystrichopsylla linsdalei*, new species**

Figs. 5, 18, 21, 26, 29

Hystrichopsylla sp., Linsdale and Davis, 1956, *Univ. Calif. Pub. in Zool.* 54: 303-304; pl. 15, figs. e-h.

Nearest *H. occidentalis* Holland, from which it can be distinguished in the male by the thick and tapering ventral arm of sternum IX, which rounds off obliquely apically; and in the female by sternum VII, which lacks a marginal lobe.

Male.—General structure and chaetotaxy much as in *H. occidentalis*. Head (Fig. 5) usually with 7 or 8 genal spines (sometimes 9 or 10). Pronotal ctenidium with about 17 spines per side. Number of apical spinelets on abdominal terga highly variable. Most usual numbers, and lower and upper limits, in 40 specimens from one series: II, 7 or 8(5-10) per side; III, 5 or 6(2-8); IV, 4 or 5(1-7); V, rarely 1.

Three antepygidial setae. Movable process of clasper broad, and exceeding fixed process (Fig. 26). Sternum VIII club-shaped and vested in many short, lateral setae directed cephalad, and a ventral fringe of long, slender setae directed ventro-caudad.

Sternum IX strongly modified and providing the most reliable diagnostic character for the species. Ventral arm of this sclerite proportionally broader than in any other species, being especially broad at the junction with the dorsal arm, and tapering gradually towards the apex (Figs. 18, 21). The dorsal margin curving gently and obliquely into the ventral at the apex. Sternum IX armed with a series of about 17 heavy spiniform setae of various sizes (13 to 21 spiniforms in 20 specimens from one series). The spiniforms may be arranged roughly in seven or eight pairs, with smaller spiniforms distributed between some of the pairs, or there may be only three or four such pairs with the remainder distributed in an irregular series. On the average, the spiniforms are larger, and fewer, than in *H. occidentalis*.

Female.–Genal ctenidium of 7 or 8 spines (20 specimens, taken at random from a single long series). Pronotal ctenidium with about 18 (17-20) spines per side. Apical spinelets on abdominal terga as follows: II, about 7 (5-10) per side; III, 4 or 5 (3-7); IV, about 2 (0-4).

Three antepygidial setae. Two equal-sized spermathecae of the *Hystrichopsylla* type. Sternum VII entire (Fig. 29) or (rarely) with a slight marginal angle, forming an inconspicuous lobe; in nearly all cases reliably separated from *H. occidentalis*, in which sternum VII is broadly truncate or rounded-truncate, sometimes with a broad shallow sinus.

Size (mounted specimens): ♂, average of 20 specimens 4.1 mm. (3.5-4.6); ♀, average of 20 specimens 5.0 mm. (4.5-5.6).

Holotype.– ♂, Berkeley Hills, Alameda Co:, California, March 23, 1954, collected from nest of *Microtus* sp., by Messrs. V. J. Tipton, E. Mendez, and G. Loshbaugh; No. 6548 in the Canadian National Collection of Insects, Ottawa.

Allotype.– ♀, same data.

Paratypes.–67 ♂ ♂ and 81 ♀ ♀ all from California, as follows: same data as holotype and allotype, 43 ♂ ♂, 46 ♀ ♀; same locality, 23.III.54, ex *Reithrodontomys megalotis longicaudus* (Baird), 1 ♂, 7 ♀ ♀ (Tipton, Loshbaugh and Mendez); same locality, 23.III.54, ex *Microtus c. californicus* (Peale), 2 ♀ ♀ (Tipton *et al.*); Strawberry Canyon, Berkeley, 26.II.54, ex *Peromyscus truei* (Schufeldt), 1 ♂ (Mendez and Loshbaugh); San Francisco, 4.IV.40, ex *Microtus* sp., 1 ♂; Glen Park, San Francisco, 12.II.54, ex nest of *Microtus californicus*, 6 ♂ ♂ 10 ♀ ♀ (H. E. Stark); Paradise, Marin Co., 15.IV.46, ex nest of *Microtus*, 3 ♂ ♂, 5 ♀ ♀ (E. L. Kessel); Colma, San Mateo Co., XII.54, ex *Microtus californicus*, 4 ♂ ♂, 9 ♀ ♀ (H.E.S.); Monterey Co., 23.XII.53, ex nest of *Neotoma* sp., 1 ♂ (G.L.); Redwood Pk., Contra Costa Co., 18.V.54, ex redwood litter (Berlese sample), 1 ♂, (Gilbert and Schuster); 6 miles N.W. of Vallejo, Solano Co., 19.VI.49, ex *Microtus?*, 2 ♂ ♂, 2 ♀ ♀ (H. E. Childs); Wrightwood, Los Angeles Co., 6000', 12.VIII.50, ex *Peromyscus boylii* (Baird), 2 ♂ ♂ (R. Traub and E. W. Jameson, Jr.); Ford Ord, 30.XI.45, ex *Microtus californicus*, 1 ♂ (R. F. Peters); Hastings Reservation, Monterey Co., 16.VI.39, ex *Peromyscus californicus*, 1 ♂ (J. M. Linsdale).

Material apparently of this species is also available from the states of Utah and Arizona. As there are suggestions of geographical variation (e.g., an apparently larger number of genal spines in the Utah specimens), these records are merely listed but the specimens are not considered to be paratypes.

Localities.–UTAH: Salt Lake Co., 2 ♂ ♂; Utah Co., 1 ♂, 1 ♀; Millard Co., 2 ♀ ♀; Tooele Co., 3 ♂ ♂, 6 ♀ ♀; ARIZONA: Coconimo Co., 2 ♂ ♂, 2 ♀ ♀.

Hosts.–Peromyscus maniculatus (Wagner), 4 ♂ ♂, 3 ♀ ♀; *P. boylii* (Baird), 1 ♂; *P. truei* (Shufeldt), 3 ♂ ♂, 2 ♀ ♀; *Neotoma lepida* Thomas, 2 ♀ ♀; *Microtus* sp., 2 ♀ ♀; *Mus musculus* L., 2 ♀ ♀.

The species is named after Dr. Jean M. Linsdale, Director of the Frances Simes Hastings Natural History Reservation, Monterey County, California. In his mammalogical investigations, Dr. Linsdale has done much to supplement the knowledge of Californian fleas, and in his recent publication recognized that the flea described above was not referable to any previously described species of *Hystrichopsylla.*

Acknowledgments

The writer is indebted to Messrs. G. H. E. Hopkins and F. G. A. M. Smit of the Zoological Museum at Tring, Herts., England, for opinions and comments and for the loan of material. Other students of Siphonaptera who loaned or donated specimens of *Hystrichopsylla* for study are: Lt. Col. Robert Traub and Lt. Vernon Tipton of the Army Medical Service Graduate School, Washington, D.C.; Dr. Wm. L. Jellison of the Rocky Mountain Laboratory, Hamilton, Montana; Messrs. F. M. Prince and H. E. Stark of the Plague Suppressive Measures Laboratory, San Francisco, California; Messrs. G. Loshbaugh and E. Mendez of the University of California, Berkeley; Dr. E. W. Jameson, Jr., of the University of California, Davis; Dr. G. F. Augustson of Madera, California; Dr. D. Eldon Beck of Brigham Young University, Provo, Utah; Dr. H. B. Morlan of the United States Public Health Service, Savannah, Georgia; Mr. John E. Lane of the United States Public Health Service, Atlanta, Georgia; and Professor G. J. Spencer of the University of British Columbia, Vancouver. To all of these, the writer expresses his thanks.

References

Holland, G. P. 1949. The Siphonaptera of Canada. *Canada Dept. Agr. Tech. Bull.* 70. 306 pp.; 350 figs.; 44 maps.

Hubbard, C. A. 1947. Fleas of western North America. Iowa State College Press, Ames. 533 pp.; numerous figs.

Ioff, I. G., O. I. Scalon, *et al.* 1950. New species of fleas (Aphaniptera); Communication II [in Russian]. *Med. Parasitol.* (Moscow) 19: 268-273.

Jordan, K. 1929. On a small collection of Siphonaptera from the Adirondacks, with a list of the species known from the State of New York. *Nov. Zool.* 35: 168-177; 4 figs.

(Received April 1, 1957)

Human Furuncular Myiasis Caused by the Flesh Fly *Wohlfahrtia opaca* (Coq.) (Sarcophagidae: Diptera)[1]

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Cases of furuncular myiasis in humans have been reported in the literature from time to time, many of them having been attributed to parasitism by sarcophagid flies. O'Rourke (10) described a case of furuncular myiasis due to *Wohlfahrtia vigil* (Walk.) in a month-old infant at Ottawa. He reviewed the life-history and distribution of the species and previous records of myiasis caused by it. Israels and Shuman (4) published an informative general review of myiasis dermatosa. Hunt and Edwards (3) reported a case in a three-month-old infant at Montreal. This is a report on similar cases that occurred at Lethbridge, Alberta, in 1953 and in 1955 and a review of other records for Western Canada and the United States.

Previous cases in Alberta were reported by Morrison (9), who listed one in Claresholm and two in Edmonton; by Lewis (7), who reported a case in a two-week-old infant in Medicine Hat; by Strickland (13), who (personal communication) occasionally has had further cases referred to him in more recent years from various parts of south-central Alberta; and by Seamans (12), who reported a case in a 10-week-old infant at Calgary in which the larva was classified as of *W. meigenii* (Schin.) or *W. vigil* (Walk.). In the western United States one case yielding 24 larvae was reported from Utah (Rich and Knowlton, 11); one from Helena, Montana (Mills, Collenback and Reinhardt, 8), and unpublished cases from Colorado (Gassner and James, 2). The most thorough case history, including clinical data, was described by Lewis (7).

All reports to date indicate that the species of sarcophagid fly described as *Wohlfahrtia opaca* (Coq.) is probably restricted to the central Great Plains and the inland Rocky Mountain areas of the northern United States and southern Canada. Although *W. vigil* has been recorded as a distinct species, causing myiasis in Eastern Canada (Ford, 1; Kingcote, 6; Walker, 15 and 16), it cannot be reliably distinguished from *W. opaca* in the immature stages. The distribution, and differences in body markings of the adults of the two forms, indicate that they are distinct races if not distinct species. Distinguishing characters were described by James and Gassner (5). They gave reasons for considering *W. meigenii* as a Palaearctic species and *W. opaca* as a Nearctic species. In view of the species distribution in North America, the case of parasitism described by Seamans (12) was probably attributable to *W. opaca* and not *W. meigenii* or *W. vigil* as reported.

Parasitism in humans by the North American species is restricted to infants well under one year of age. Larvae are unable to penetrate the skin of older children or adults.

The following are case histories reported to the Lethbridge laboratory:—

I. A premature, month-old baby from the town of Picture Butte had been exposed regularly outdoors in a carriage. Two larvae were removed from pustules on the neck by the mother before the case was reported. The infant was admitted to St. Michael's Hospital for treatment by Dr. T. E. Brown. Another third-instar larva removed during hospitalization was preserved and brought to the laboratory on June 19, 1953, and identified as of *Wohlfahrtia* sp.

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[2]Officer-in-Charge and Associate Entomologist.

II. A 2½-month-old infant in Hardieville (north Lethbridge) had been exposed outdoors during the afternoons at its home and once while visiting three miles northeast of Lethbridge on July 12, 1953. Dr. J. A. McNally removed six larvae from pustules on the neck on July 15 and one on July 16 and referred them to the laboratory through Dr. S. M. Schmaltz. The larva collected on July 16 pupated overnight. Four larvae were placed on fresh liver and one subcutaneously on a young guinea pig. The larva in the guinea pig was lost. Three of the four that were reared on liver pupated on July 21. The adults that emerged on August 4 were of *W. opaca.*

III. A 4½-month-old infant in the town of Picture Butte slept outdoors regularly in a carriage. After the appearance of lesions in the anterior region of the axilla, the infant was admitted to St. Michael's Hospital for treatment by Dr. J. E. Morgan. Eight third-instar larvae were removed from the axilla on July 18, 1953. Four of the larvae were reared on fresh liver at the laboratory, and pupated on July 25 and 26. Three adults of *W. opaca* emerged on August 8.

IV. On July 17, 1953, at Picture Butte, parents removed a grub from the left side of the neck of an infant nearly six months old. When first observed, the grub was beginning to emerge from a pustule a little above the hair line near the back of the neck. The parents had not noticed a lesion earlier and assumed that they had removed a grub as it was burrowing into the skin. The grub was destroyed but was probably of *W. opaca.*

V. A. 15-day-old infant was brought to Dr. W. E. Bryans at the Campbell Clinic, Lethbridge, on June 19, 1955. The mother had already removed several larvae from the child's neck. Dr. Bryans removed one larva from the fold of the plantar surface at the base of the right index finger. Another apparently had been present in a fold in the mesial surface of the left wrist, but was absent at examination. On July 20 more lesions appeared and the infant was examined by Dr. F. Johnson of the same clinic, who removed at least 30 more larvae. He noted that there were three distinct ranges in the size of the larvae. This suggests that the infant was subjected to more than one attack by the same or different flies. Only one larva was taken from each lesion. All were discarded at the clinic. We visited the child on June 23 and confirmed the diagnosis of *Wohlfahrtia* parasitism from the appearance and distribution of the lesions.

A non-human case of myiasis was that of a month-old kitten on a farmstead 1½ miles outside Lethbridge. In early August, 1953, this kitten had two lesions in a raw, licked area in the right posterior quadrant of the abdomen, each of which contained two larvae. These were reared and one adult of *W. opaca* emerged.

The number of cases reported in so short a period in Lethbridge and nearby localities indicates that the adult flies were probably unusually abundant. Since many physicians in the area were not previously familiar with this condition, it is possible that other cases occurred and were not reported. Walker (14) mentioned the improper diagnosis of many cases of myiasis in Ontario as impetigo or furunculosis. He suggested that more recent records of myiasis in new areas may result from increased familiarity of physicians with the parasitic habits of some muscoid flies as well as from changes in the distribution of the species.

Gassner and James (2) stated that the incidence of cutaneous myiasis in lower mammals caused by *Wohlfahrtia* spp. is much more extensive than has been reported. Since the most alarming outbreaks of myiasis caused by these species have occurred in foxes and mink in Minnesota and in southern Ontario (Kingscote, 6), the flies may be suspected of normally parasitizing lower mammals. Parasitism of human infants may occur in years when flies of *Wohlfahrtia*

spp. are unusually abundant and an insufficient number of lower mammals are available as hosts. Although the incidence of myiasis at Lethbridge was unusual in 1953, there was only one case during the following three years.

Gassner and James (2) described the food habits of *Wohlfahrtia* adults. They are attracted to flowers and sweet materials. These authors suggested that their food habits have a bearing on larval infestations. They cited cases in which heavy infestations on mink and fox farms disappeared when pens were moved from fields planted with crops such as alfalfa and rye. The cases at Lethbridge were from suburban areas and nearby communities close to farms commonly planted with these crops.

The natural behaviour of many parasitic muscoid flies is normally beyond the observation of the entomologist. It would be of definite value if physicians and veterinarians would forward alive all larval material to the nearest university or government entomologists. Complete clinical data should also be included. If the larvae can be reared to the adult stage, confirmation of the diagnosis is much easier. Thus the entomologist would assist the medical profession as well as increase his own knowledge of the environmental aspects of parasitism.

Acknowledgments

We wish to thank the physicians mentioned in this report for bringing their cases to our attention, and for permission to publish them.

References

Ford, N. 1936. Further observations on the behaviour of *Wohlfahrtia vigil* (Walk.) with notes on the collecting and rearing of the flies. *J. Parasitol.* 22: 309-328.

Gassner, F. X., and M. T. James. 1948. The biology and control of the fox maggot, *Wohlfahrtia opaca* (Coq.). *J. Parasitol.* 34: 44-50.

Hunt, B. R., and P. Edwards. 1951. Dermal myiasis in Eastern Canada. *Can. Med. Assoc. J.* 64: 69.

Israels, S., and B. Shuman. 1949. Myiasis dermatosa in infancy. *Pediatrics* 4: 665-669.

James, M. T., and F. X. Gassner. 1947. The immature stages of the fox maggot, *Wohlfahrtia opaca* (Coq.). *J. Parasitol.* 33: 241-244.

Kingscote, A. A. 1934. *Report Ontario Vet. College* p. 51.

Lewis, L. 1947. Cutaneous myiasis occurring in Western Canada. *Can. Med. Assoc. J.* 56: 319.

Mills, H. B., J. A. Callenbach, and J. F. Reinhardt. 1945. *Montana Insect Pesto Bull.* 425: 23.

Morrison, F. O. 1937. Myiasis in the foot of a rat by *Wohlfahrtia meigenii* Shiner (Diptera: Metopiidae) *Can. Ent.* 69: 266-269.

O'Rourke, F. J. 1954. Furuncular myiasis due to *Wohlfahrtia vigil* (Walker). *Can. Med. Assoc. J.* 71: 146-149.

Rich, C. L., and G. F. Knowlton. 1937. Myiasis of baby in Utah. *J. Econ. Ent.* 30: 678.

Seamans, H. L. 1942. *Can. Insect Pest Review* 20: 91.

Strickland, E. H. 1949. *Wohlfahrtia* (Diptera: Metopiidae) myiasis of mink in Alberta. *Can. Ent.* 81: 58-60.

Walker, E. M. 1920. *Wohlfahrtia vigil* (Walker) as a human parasite (Diptera: Sarcophagidae). *J. Parasitol.* 7: 1-7.

Walker, E. M. 1931. Cutaneous Myiasis in Canada. *Can. Publ. Health J.* 22: 504-508.

Walker, E. M. 1937. The larval stages of *Wohlfahrtia vigil* (Walker). *J. Parasitol.* 23: 163-174.

Life-History of the European Red Mite[1]

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Since 1945, the European red mite, *Metatetranychus ulmi* (Koch) [=*Paratetranychus pilosus* (C. & F.)], has been one of the major pests in apple orchards in southwestern Quebec. Though it had been noted by Petch[3] on fruit trees at Ville LaSalle, Que., in 1930 and at Lac Mégantic, Que., in 1931 it was not reported as causing serious injury to apple trees before July of 1945, when Beaulieu (1948) reported that it was responsible for the first important damage in a few orchards at Rougemont, Que. By 1946, infestations were general in the apple growing areas of southwestern Quebec and occurred as far east as the Quebec City district.

The importance of this pest prompted studies on its life-history under Quebec conditions. This is a report on rearing summer eggs, larvae, nymphs and adults for each generation from 1948 to 1950 in an insectary and on observations of overwintering eggs in the orchard from 1949 to 1951, at Rougemont, Que.

Groves (1951) listed over 1,000 references to *M. ulmi* and its predators. Of these, the following contain data obtained under climatic conditions comparable to those in southwestern Quebec. Ross and Robinson (1922), in an extensive study on the life-history, found six generations a year in plum orchards in southeastern Ontario, the overwintered eggs hatching about when plum trees bloomed. Garman (1923), studying the mite on apple trees in Connecticut, reported data similar to those for southeastern Ontario, the overwintered eggs hatching when the apple tree buds were at the pink stage. In the Pacific northwest, Newcomer and Yothers (1929) observed eight generations a year on apple trees, with almost the same durations for the life stages as in Ontario and Connecticut. In a comprehensive study in Nova Scotia, Gilliatt (1935) recorded five generations a year. Cagle (1946), in Virginia, found nine generations a year, the overwintered eggs hatching at the pink stage of apple. In preliminary studies in Quebec, Beaulieu (1948) observed seven generations and noted that the overwintered eggs hatched at the pink stage of apple; also, Beaulieu and Parent (1953) confirmed these data and reported some eggs and nymphs of an eighth generation. About the same time, Blair and Groves (1952), in England, reported approximately the same durations of the life stages and the same number of generations as in Nova Scotia.

Materials and Methods

In 1948 the mite was reared on apple tree twigs eight to ten inches long, in quart fruit jars half-filled with water as described by Cagle (1946). But in 1949 and 1950, a more nearly natural habitat was provided: year-old grafted Duchess and Yellow Transparent apple trees grown in pots five to seven inches in diameter. The soil in each pot was kept moist by adding water to the supporting saucer.

The rearing cells used were those described by Cagle (1946), each female being isolated on a leaf section by means of a piece of celluloid surrounded by a tanglefoot barrier. For mating, in the quiescent deutonymph stage each female was supplied with an adult male. To determine the number of eggs laid per female per day, females were transferred daily to new rearing cells. Data

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[3]Petch, C. E. Annual reports of the Dominion Entomological Laboratory, Hemmingford, Que., 1930-31.

were recorded daily on: the laying and hatching of eggs; the feeding and quiescent periods of larvae, protonymphs, and deutonymphs; the number of eggs laid by each female; and the longevity of adults. Data were obtained on progeny of each female from the first to the last generation. A generation was taken as beginning with the laying of eggs and ending at the death of the last adult female.

Behaviour and Durations of Stages

Overwintering Eggs

Overwintering eggs were laid from mid August to early October by females of the fourth and later generations. They were deposited on the wood of apple trees, usually on the south sides of the trees, on the lower sides of the branches, on fruit buds, in cracks and crevices of the bark, and even around the blossom ends of apples.

For the three years recorded (1949-1951), the winter eggs hatched during a period of 10 to 15 days and most of them at the pink stage of apple. Fig. 1 shows that the percentage of hatching varied from year to year, and that the shorter and the earlier the hatching period the higher the percentage of hatching.

Summer Eggs

In insectary rearing in 1949 and 1950, the majority of summer eggs were laid on the lower surfaces of the leaves. Summer eggs were observed from late May or early June to early September or October, the period varying from three to four and a half months. The incubation period of summer eggs averaged seven to nine days, and was a little longer in the first and last generations because of cooler temperatures. Moreover, the summer eggs of the eighth

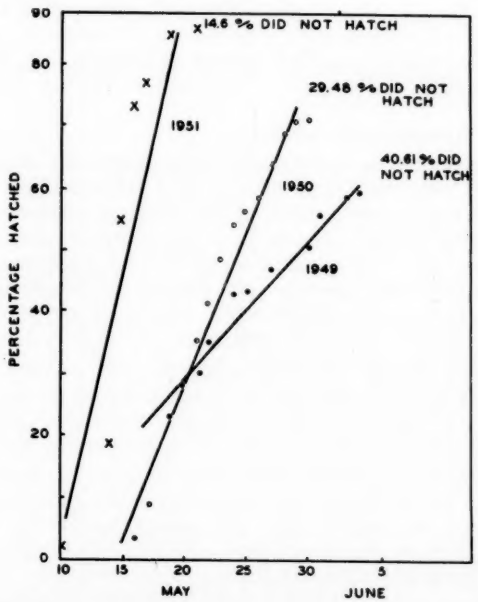

Fig. 1. Relation between the percentage of winter eggs of the European red mite that hatched and the period of hatching.

TABLE I

Data on summer eggs of the European red mite, in insectary rearing at Rougemont, Que., 1948-1950

Year and generation	Number of eggs observed	Percentage laid on lower surfaces of leaves	Laying Period	Hatching Period	Incubation period, days		
					Maximum	Minimum	Mean
1948							
Second....	107	—	June 4–21	June 17–28	17	8	12.5
Third.....	216	—	June 25–July 16	July 1–21	13	6	8.3
Fourth....	198	—	July 7–Aug. 16	July 14–Aug. 26	11	6	8.6
Fifth.....	162	—	July 23–Sept. 6	July 31–Sept. 19	13	5	7.8
Sixth.....	57	—	Aug. 12–Sept. 20	Aug. 21–Oct. 3	22	5	9.1
Seventh...	2	—	Sept. 7–8	Sept. 23–26	18	16	17.0
1949							
Second....	69	86.0	May 22–June 15	June 9–28	18	5	10.2
Third.....	132	83.7	June 15–July 3	June 24–July 12	11	5	8.5
Fourth....	73	78.3	July 3–20	July 13–27	10	6	7.8
Fifth.....	186	76.0	July 20–Aug. 12	July 27–Aug. 24	12	3	7.0
Sixth.....	115	62.5	Aug. 1–26	Aug. 8–Sept. 5	13	6	9.5
Seventh...	34	84.4	Aug. 17–Sept. 30	Aug. 27–Sept. 30	24	8	12.2
Eighth....	4	100.0	Sept. 19–Oct. 9	Did not hatch			
1950							
Second....	190	73.6	May 28–June 18	June 8–28	14	8	11.6
Third.....	152	89.8	June 20–July 12	June 29–July 22	12	7	8.5
Fourth....	63	88.1	July 10–25	July 18–31	13	8	9.3
Fifth.....	110	82.4	July 27–Aug. 17	Aug. 7–27	11	8	8.4
Sixth.....	111	85.0	Aug. 15–Sept. 24	Aug. 22–Oct. 4	24	6	14.0
Seventh..	15	90.0	Sept. 17–Oct. 11	Did not hatch			

generation in 1949 and those of the seventh in 1950 did not hatch because of lower temperatures (Table I).

Notes on Larvae, Nymphs, and Adults

The three instars and the adults have been extensively described elsewhere. The following are brief notes on these stages. Observations on durations of the feeding and the quiescent periods of the immature stages revealed the total feeding period to be slightly shorter than the quiescent one (Table II). For the three years recorded the total duration of these two periods, i.e., from hatching to adults, averaged from four to eight days in the first five generations, but was mostly longer in the sixth and seventh. The larval and protonymphal stages were about equal, but the deutonymphal stage was slightly longer.

On the average the preoviposition period, with a slight variation, lasted from one and a half to two and a half days, being usually longer in the sixth and seventh generations (Table III). A few females of the sixth generation required 14 and 18 days in 1949 and 1950 respectively before laying their first eggs.

The mean oviposition period lasted from four to 12 days, although some females of the fifth generation in 1950 oviposited over a period of 30 days. This is a maximum rarely reached, because the average life of the female reared in the insectary varied from five to 15 days, although a very few females of the later generations lived as long as 32 days.

In the insectary, so many factors influence the number of eggs laid per female that it is almost impossible to determine in which generation the females are generally the most prolific; in some years those of the first generation were;

TABLE II

Average durations in days of larval and nymphal stages of the European red mite, in insectary rearing at Rougemont, Que., 1948–1950.

Year and generation	Number observed	Larva			Protonymph			Deutonymph			Total		
		Feeding	Quiescent	Mean	Feeding	Quiescent	Mean	Feeding	Quiescent	Mean	Feeding	Quiescent	Mean
1948													
Second	31	1.5	1.2	2.3	1.2	1.1	2.3	1.0	1.1	2.6	3.7	3.4	7.1
Third	39	0.9	1.1	2.0	0.9	1.0	1.9	1.0	1.1	2.2	2.8	3.2	6.0
Fourth	63	1.1	1.1	2.1	1.3	1.1	2.4	1.3	1.2	2.6	3.7	3.4	7.0
Fifth	43	1.2	1.2	2.5	1.1	1.2	2.4	1.3	1.3	2.6	3.6	3.7	7.4
Sixth	17	1.5	1.3	2.8	1.7	1.8	3.5	1.8	2.3	4.1	3.0	5.4	10.4
Seventh	1	2.0	3.0	5.0	2.0	2.0	4.0	2.0	4.0	6.0	6.0	9.0	15.0
1949													
Second	22	0.9	0.8	1.8	0.5	0.6	1.2	0.5	0.8	1.4	2.0	2.4	4.4
Third	28	0.9	0.9	1.9	0.6	0.6	1.4	0.6	0.8	1.5	2.3	2.4	4.8
Fourth	26	0.9	0.8	1.7	0.8	0.8	1.6	0.8	0.9	1.7	2.5	2.6	5.1
Fifth	37	1.1	1.1	2.2	1.1	1.1	2.0	0.9	1.2	2.1	2.9	3.4	6.4
Sixth	32	1.0	1.1	2.2	1.4	1.4	2.6	1.2	1.5	2.7	3.5	4.0	7.5
Seventh	17	1.4	1.3	2.8	2.0	2.0	3.4	2.0	3.7	5.6	4.7	7.0	11.8
1950													
First	25	1.9	1.6	3.5	0.8	1.1	1.9	0.9	1.4	2.3	3.6	4.2	7.8
Second	60	1.1	1.3	2.4	0.9	1.5	2.4	1.1	1.7	2.9	3.1	4.6	7.8
Third	58	1.0	0.9	1.9	0.8	1.0	1.9	0.9	1.3	2.2	2.8	3.2	6.0
Fourth	27	1.1	0.9	2.0	1.0	1.2	2.2	1.2	1.2	2.4	3.3	3.3	6.7
Fifth	49	1.0	1.1	2.1	0.9	1.3	2.2	1.2	1.6	2.9	3.2	4.0	7.3
Sixth	46	1.3	1.8	3.4	1.4	2.3	3.7	1.8	3.1	5.0	4.8	7.3	12.1

in others, those of the third and the fourth. The females of the first five generations laid an average of 10 to 35 eggs, but some females of the fourth generation in 1949 laid as many as 90 eggs each. Those of the sixth and seventh generations laid few eggs.

Numbers and Durations of Generations

The numbers of generations reared in the insectary for the three years are shown in Fig. 2. In 1948, 1950, and 1951 there were six generations; in 1948 and 1950 a seventh generation had eggs, larvae, and nymphs but no adults. In

TABLE III

Average durations in days of various periods for females of the European red mite and numbers of eggs laid in insectary rearing at Rougemont, Que., 1948–1950

Year and generation	Number females observed	Preoviposition period			Oviposition period			Longevity of all female stages			Number of eggs laid per female		
		Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean
1948													
First	16	5	1	2.0	9	1	4.0	14	3	9.6	16	1	7.5
Second	20	2	1	0.7	14	1	5.4	15	2	7.1	43	1	15.6
Third	21	2	1	1.5	12	1	5.0	12	3	6.7	37	1	15.3
Fourth	23	4	1	1.8	17	1	7.8	18	2	9.9	36	1	16.3
Fifth	10	5	1	2.5	13	1	4.0	32	2	11.4	19	1	7.5
Sixth	1	1	1	1.0	2	2	2.0	29	4	14.0	2	2	2.0
1949													
First	20	3	1	1.6	12	1	5.2	16	2	7.2	26	1	7.8
Second	7	2	1	0.8	12	2	6.5	13	2	7.4	55	4	26.7
Third	7	2	1	1.3	9	2	5.4	10	3	7.0	41	1	20.7
Fourth	24	2	1	1.4	21	1	9.0	22	2	9.8	90	1	35.0
Fifth	21	3	1	1.6	20	1	8.3	21	2	9.4	56	4	26.1
Sixth	18	14	1	4.5	20	2	8.1	24	3	9.1	36	1	11.7
Seventh	3	7	5	6.0	25	5	12.0	26	4	13.0	4	1	2.0
1950													
First	32	3	1	1.2	18	1	6.0	19	2	6.9	76	1	20.3
Second	27	2	1	1.1	15	1	5.1	16	2	5.8	50	1	15.9
Third	14	2	1	1.3	9	1	4.5	10	3	5.7	21	3	11.3
Fourth	10	3	1	1.4	13	1	5.5	16	2	7.0	41	1	13.6
Fifth	25	7	1	2.2	32	1	10.0	32	2	12.0	36	1	10.9
Sixth	7	18	3	8.0	18	3	8.5	23	6	15.0	4	1	1.5

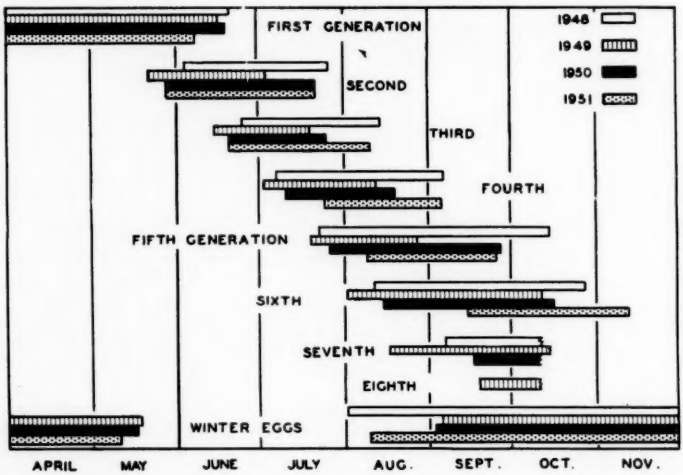

Fig. 2. Numbers and durations of generations, 1948 to 1951 (broken lines indicate generations without adults).

1949, seven generations were recorded; eggs of an eighth generation were produced but did not hatch.

The durations of the second to fifth generations averaged about 24 days, the later ones being considerably longer (Table IV). However, in 1949, the four generations were somewhat shorter, probably as a result of a higher temperature throughout the season. On the average, the third generation was the shortest and for all generations the duration varied from 20.5 to 37 days.

Discussion

According to the literature reviewed there are two main lines of thought in designating the number of European red mite generations occurring within a year. For instance, Gilliat (1935), Newcomer and Yothers (1929), and Ross and Robinson (1921) identified the generations as complete and incomplete or partial. In brief, these authors consider a generation as complete only

TABLE IV

Average durations in days of generations of the European red mite in insectary rearing at Rougemont, Que., 1948–1950

Generation	1948	1949	1950	Mean
Second	26.7	21.8	25.7	24.7
Third	21.0	20.3	20.2	20.5
Fourth	25.5	22.7	23.0	23.7
Fifth	26.6	22.8	27.7	25.7
Sixth	33.5	26.1	41.1	33.5
Seventh	—	37.0	—	37.0

when all individuals reach the adult stage, and as incomplete or partial when some individuals do not reach maturity.

Other authors, e.g., Blair and Groves (1952), Cagle (1946), and Garman (1923), consider as partial only the generations in which no individuals complete their life cycle during the year. In this paper, in the latter sense the authors have shown that, in southwestern Quebec as in the Pacific northwest (Newcomer and Yothers, 1929), there are six complete generations, an incomplete seventh, and sometimes an incomplete eighth. Although in some years the first winter eggs are laid by some females of the fourth generation, the fifth and the sixth generations may still be designated as complete generations according to the second group of authors mentioned above.

Summary

In studies on the European red mite, *Metatetranychus ulmi* (Koch), at Rougemont in southwestern Quebec from 1948 to 1951, overwintering eggs were laid on apple trees from mid August to early October of each year and hatched the following spring about the time the apple trees bloomed. The majority of summer eggs were laid on the lower surfaces of the leaves, where the immature stages developed. The incubation period of summer eggs averaged from seven to nine days and the immature stages from four to eight days. The females had a preoviposition period of about one and a half to two and a half days and an oviposition period of four to 12 days, and laid on the average from 10 to 35 eggs. There were six generations each year, and a seventh in 1949. In 1948 and 1950 all stages but adults of a seventh generation were recorded, and in 1949 eggs of an eighth generation were produced. The mite was reared on year-old grafted Duchess and Yellow Transparent trees grown in pots in the insectary.

References

Beaulieu, A. A. 1948. Résultats préliminaires des expériences entreprises en 1948 sur le tétranyque du pommier (mite rouge). *55è Rapp. Ann. Soc. Pom. Québec,* pp. 52-57.

Beaulieu, A. A., and B. Parent. (1953) Résultats préliminaires de deux saisons d'études (1948-1949) sur le cycle vital du tétranyque du pommier, *Metatetranychus ulmi* (Koch) = *Paratetranychus pilosus* (C. & F.). 32nd and 33rd Repts. Québec Soc. Prot. Plants, 1950-51, pp. 122-126.

Blair, Catherine A., and Joan R. Groves. 1952. Biology of the fruit tree red spider mite, *Metatetranychus ulmi* (Koch) in southeast England. *Hort. Sci.* 27: 14-43.

Cagle, L. R. 1946. Life-history of the European red mite. *Virginia Agr. Expt. Sta. Tech. Bull.* 98.

Garman, P. 1923. The European red mite in Connecticut apple orchards. *Connecticut Agr. Expt. Sta.* (New Haven) *Bull.* 252.

Gilliatt, F. C. 1935. The European red mite, *Paratetranychus pilosus* (C. & F.) in Nova Scotia. *Canadian J. Res., D,* 13: 1-17.

Groves, Joan R. 1951. A synopsis of the world literature on the fruit tree red spider mite, *Metatetranychus ulmi* (C.L. Koch, 1835) and its predators. Commonwealth Institute of Entomology, 41 Queen's Gate, London, S.W. 7.

Newcomer, E. J., and J. A. Yothers. 1929. Biology of the European red mite in Pacific northwest. *U.S. Dept. Agr. Tech. Bull.* 89.

Ross, W. A., and W. Robinson. 1922. Notes on the plum spider mite or European red mite. *52nd Ann. Rept. Ent. Soc. Ontario,* 1921, pp. 33-42.

A New Species of the Tribe Trogini (Hymenoptera: Ichneumonidae)

By GERD H. HEINRICH
Dryden, Maine.

Conocalama catalinarum spec. nov. ♂

Type locality.—Mt. Lemmon, 9,000 ft., St. Catalina Mts., Arizona.

Holotype.— ♂ H. E. Evans, 2-4 Aug. 1948, C.N.C. No. 6529.

Paratypes.—7 ♂ ♂ from type locaity, H. E. Evans, 2-4 Aug. 1948 in Canadian National Collection, Cornell Coll., G. H. Heinrich Coll.

A uniformly deep black species. Wings yellowish-brown with a distinct black band at the end, the base being indistinctly infuscated. Mimics strongly the colour and general appearance of some *Pepsis* species of the southwestern States. Length, 28 mm.

Male

Inner orbits more or less, middle of clypeus and an indistinctly limited area around the middle of outer orbits obscurely reddish or yellowish red. Flagellum with short oval thyloides on joints 4-25-26, almost black, usually obscurely ferrugineous below and the joints of the basal third with reddish base at the outer side.

Agrees morphologically with *brullei* Cress. except that the notaulices are somewhat more strongly developed and extend over the middle of the mesonotum. Elevation of the postpetiole well developed with a more or less pronounced deepening in the middle of its posterior slope.

Book Notices

[THE CHALCID FAUNA OF THE U.S.S.R.], by [M. N. Nikol'skaya], [Opred. Faune S.S.R.] 44, 1952, pp. 574, figs. 592 (in Russian).

Nikol'skaya's monograph belongs to the "Opredeliteli" (or, broadly speaking, the "Taxonomic Guide") series. This was started in 1927 but its numbering from at least 1950 onwards seems to mesh with that of the Fauna U.S.S.R. The latter started in 1911, with a New Series in 1935. The recent numbering suggests contribution numbers for the Zoological Institute of the Academy of the U.S.S.R., rather than the separate numbering of two series. As with the other faunal volumes, Nikol'skaya's has been difficult to obtain, coming to hand only in 1955.

The publication of the Fauna series is of great interest to Western taxonomists, although also a source of embarrassment to those of us without some knowledge of the Russian language. Nevertheless, in this case an extensive familiarity with this tongue is not needed for the most part. Keys occupy 469 pages and are written in the usual abbreviated style; thus no verbs as such appear, while nouns and adjectives are in the nominative, or follow a preposition, or occur in a recognisable participle phrase. Grammatical pitfalls are restricted mainly to the recognition of plural nouns, of comparative adjectives and of adverbs. A vocabulary of less than 500 words is necessary for these keys, supplemented by the list of common names for Russian insect hosts (pp. 566-8). The meanings of morphological terms can be found through the illustrated preliminary discussion upon taxonomic morphology. Ignorance of Russian is therefore not an insurmountable barrier to reading at least the main part of Nikol'skaya's work.

This monograph needs special appraisal as the only extensive palaearctic work upon the Chalcidoidea since that of Schmiedeknecht (1909). The preface has 60 pages upon the taxonomic history, immature and adult morphology, dimorphism, biology, parasitism and phytophagy, palaeontology, geographical distribution and economic phases, as well as the handling of specimens. A bibliographical list includes almost 20 Russian titles and 85 foreign ones; these are frequently referred to in the keys. Those families keyed only to genus have many generic data added to the couplets. A short host-parasite list is included.

Nikol'skaya has deserted the Ashmead-Schmiedeknecht tradition by recognising in the Chalcidoidea twenty-four families, without subfamily or tribe. In the difficult complex of the Cleonymidae, Pteromalidae, Tridymidae, Miscogasteridae, and Spalangiidae, only the latter is keyed to species, the remainder to genus. The Mymaridae and the Eulophidae s.l. (except Aphelinidae) are also keyed only to genus. The perplexing Eurytomidae and twelve other families, mostly small, are keyed to species. With numerous line drawings these form a very helpful tool to the taxonomist.

The scope of the monograph is not entirely Russian, some species from western Europe being included, as well as a new genus having a new north African species, *Urochalcis maura*. Four new genera and ninety-one new species are described within the keys. These species descriptions are invariably brief, the sex not always given, and rarely supplemented by figures. The locality is usually given as the name of a Soviet republic, sometimes even vaguer. No mention was found of the present location of the types.

Many of the names are still used in the Schmiedeknecht manner. *Callimome* Spin. and Callimomidae are used for *Torymus* Dalm. and Torymidae, although the name *Callimome* was suppressed in 1944. Generic names such as *Polycelis* Thoms., *Dinotus* Foerst., *Eutelus* Wlkr., *Picrocytus* Thoms., *Gitognathus* Thoms., *Cerambycobius* Ashm., *Eucomys* Foerst. and *Microplectron* Dahlb. are still used. This failure to keep in step with modern changes in nomenclature may well be caused by the scientific isolation of Russia for so many years; indeed, this is suggested by Nikol'skaya's list of western references being limited almost entirely to the years previous to 1940. In spite of this, this monograph has a worthy place upon the taxonomic shelf.

O. Peck

TAXONOMIST'S GLOSSARY OF GENITALIA IN INSECTS. Edited by S. L. Tuxen. 8vo. Bd. Copenhagen (Ejnar Munksgaard). 1956. Pp. 284. Price D.kr.80.

This very useful book is intended as an aid to the amateur taxonomist and to the museum taxonomist who may have to identify insects with which he is not familiar. It should be a valuable aid to the beginning student also.

The first part (158 pages) consists of twenty-nine sections, each devoted to a special group and prepared by a specialist in that group. The treatment is necessarily brief, and because of the great variations in male genitalia even within the same group, the beginner may at times find it difficult to reconcile the structures he finds in an individual species with the description and figures given in the book. This, however, is compensated for by the inclusion in each section of a select list of important references.

In a work of this kind it is inevitable that there should be some uneveness in the sections as regards both the treatment and the illustrations. It would have been easier to consult if there has been page headings and if the legends for the figures had been placed on the corresponding plates. On the whole, however, the treatment is adequate and the work should fill a long-felt need.

The second part is a very valuable glossary which attempts to list all descriptive terms used for genitalic structures, chiefly Latin, English, French and German. More than 4000 terms are defined, nearly 900 of which refer to the genitalia of the Lepidoptera. This list should be invaluable not only to the amateur but to the museum specialist. It should be of assistance to the morphologist also, but what impresses the morphologist most is the enormous lack of uniformity in the terminology even of structures whose homologies have been well established. This is not meant as an adverse criticism of the book but of the failings of taxonomists as a group.

The basic structure of the ovipositor is uniform throughout all groups, and, nearly always, the component parts can be recognized without difficulty, yet even here there is not complete uniformity in terminology.

Uniform terminology for male genitalia presents a much more difficult problem. The available evidence suggests that the origin and initial stages of development of the penis or phallus are essentially the same in all groups. Therefore the basic structure must be the same, but it is often impossible to recognize homologous phallic structures in the adult unless the development of the organ has been followed. In addition, the wide variety of accessory structures, those of one group often having no recognizable relation to those of another, makes the use of a multiplicity of terms unavoidable, but it might be thought that specialists in any one group could arrive at some greater uniformity in terminology within the group.

Perhaps the morphologist is partly to blame for the incomplete knowledge of homology in the genitalia, but where he has given a lead the taxonomist has not always followed it, and there seems to be little excuse for lack of uniformity in the use of such basic terms as penis, aedeagus, paramere, gonocoxite, gonapophysis, stylus and many others.

E. Melville DuPorte

Entomological Society of Canada

The results of the election by mail ballot for 1957 were as follows:—

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